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# INDIANA UNIVERSITY STUDIES

Contributions to Knowledge made by Instruc-  
tors and Advanced Students of  
the University



VOLUME IX

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Study No. 52

PHILO JUDAEUS, ON THE CONTEMPLATIVE LIFE.

Translation, Notes, and an Essay on Philo's Religious  
Ideas. By FRANK WILLIAM TILDEN, Professor  
of Greek in Indiana University



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# Philo Judaeus, on the Contemplative Life

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By FRANK WILLIAM TILDEN  
*Professor of Greek in Indiana University*

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## I

(M. 471) Now that I have discoursed concerning the Essenes, who zealously followed and diligently cultivated the practical life<sup>1</sup> *in all its aspects*, or, to use an expression that will be less objectionable, *in most of its aspects*, I shall proceed, after the projected plan of my work in the regular order, to speak of what seems appropriate concerning those also who have embraced the contemplative life. I shall introduce nothing of my own views just to make a better case, as is customary with the poets and chroniclers thru a scarcity of good examples, but sincerely adhering to the truth itself in the presence of which I know that even the cleverest speaker will sometimes give up. Yet one must fight it out along this line, and struggle earnestly to succeed. For it is not right that the magnitude of these men's virtues should be the cause of silence to those who believe that nothing truly fine and noble should be passed over in silence.

But the vocation of these philosophers is revealed at once by the very name, for they are called "Therapeutae" and "Therapeutrides"<sup>2</sup> (healers, male and female), in accordance with the etymology of the words.

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<sup>1</sup> Altho the Essenes were popular among many, yet possibly there were some who would object to any such sweeping statement. The Essenes were confined to Syria, as we learn not only from Philo but from Josephus and Pliny. Philo varies in his account of their numbers, telling us in his treatise *Quod Omnis Probus Liber* that there were about 4,000 of them, and in his *Apology for the Jews* that they numbered tens of thousands.

<sup>2</sup> The word "Therapeutae" is used both for "healers" and for "worshippers". It seems that Eusebius thought that since John Mark had visited Alexandria and doubtless had a goodly following there, Philo must be describing the early Christians under the guise of the Therapeutae. If so, these would then be the first Christian monks. But this is not so. Some authorities think that this little essay by Philo and the preceding one about the Essenes alluded to above belonged to a longer *Apology for the Jews*, which may have been prepared previously but was used by Philo when on the embassy to the Emperor Caligula in 40 A.D. It sought to show the Gentiles the attractiveness of at least two Jewish cults.



Truly this is either because they make profession of an art of medicine better than the one now in vogue in the cities;<sup>3</sup> for that, to be sure, only cures men's bodies, while this cures souls also that are overmastered by grievous and all-but-incurable maladies, with which pleasures and passions and griefs and fears, and greed and follies and injustice, and the countless multitude of all other lusts (M. 472) and vices have visited them. Or, they are so called, because they have been educated to this by nature, and by the holy laws to worship the Supreme Being who is superior to the good and more unmixed than the one, and more ancient than unity in origin.

And who is there, out of all those who make profession of piety, that we can compare with these? Can we compare with them, people who worship the elements, earth, water, air, and fire? To these elements different persons have given different names, as, for example, those who call fire Hephaestus,<sup>4</sup> presumably because of its power to kindle; or the air Hera because of being raised up and lifted on high; or water Poseidon, perhaps because it is potable; or earth Demeter because it seems to be the mother of all, both plants and animals. But such names are the fabrications of the Sophists (shallow thinkers) while the elements are soulless matter and cannot move of themselves, being subjected by the skilled artisans to all sorts of forms and qualities.

But what about those who worship the results of creative skill—the sun, moon, or the other stars, planets or fixed stars, or the heaven as a whole, or the universe? But even these did not arise of themselves, but by some creator most perfect in wisdom. Or shall we compare them with those who worship the demigods? Really that would be ridiculous for how can the same being be both immortal and mortal?<sup>5</sup> For apart from the fact that the very source of the generation of these creatures is censurable, they are tainted with

<sup>3</sup> We find a similar disparagement of physicians in Mark 5, 25-26: "And a certain woman [followed him] which had an issue of blood twelve years, and had suffered many things of many physicians, and had spent all that she had, and was nothing bettered, but rather grew worse." The Therapeutae excelled ordinary healers because they were physicians not of the body but of the soul.

<sup>4</sup> Such fanciful etymologies were common even in the Classical period as is seen by many examples in Plato's *Phaedrus*. It is impossible to keep the puns in English. Philo regards Hephaestus as derived from ἀπτομαι, Hera from αἶρω, Poseidon from πίνω, πόντον, and Demeter from μέτηρ. The last is the only correct one.

<sup>5</sup> Plato in the *Symposium* 202 E. says that every spiritual being is between God and mortals, but God himself has no direct dealings with men. In Jewish and Christian literature, angels are mediators between man and God.

youthful indiscretion which men dare impiously to attribute to the blessed and divine powers, declaring that they were madly in love with mortal women and had intercourse with them, when in reality they are free from all lusts and are thrice-blessed beings.<sup>6</sup>

But shall we compare them with people who worship rude idols and images? The substances of these are stone and wood which a short time before were utterly shapeless until the stone-cutters and wood-carvers cut them out of their natural materials, while their cognate and related portions are made into water-pails and foot-tubs, and into other vessels of even more ignoble uses which serve for purposes that are dark rather than for those that will bear the light.

It is right not even to call to mind the practices of the Egyptians, who have wrongly introduced into divine honors unreasoning beasts, not only domesticated animals, but even the fiercest of wild beasts, from every species under the moon; from land animals, the lion; from those that live in the water, the native crocodile; from creatures of the air, the kite and the Egyptian ibis. And altho they recognize that these animals are born and have need of food, and that they are in fact insatiate of food, and full of excretions, and are venomous and man-eating, and susceptible to all kinds of diseases, and that they are often killed not only by a natural death, but also by violence, still these civilized people worship these wild and untamable beasts, these rational beings revere irrational brutes, and tho they have (M. 473) kinship with the divine they worship creatures not to be compared even to Thersites-like apes; and altho they are rulers and lords of creation they worship those who are by nature their subjects and slaves.<sup>7</sup>

## II

But inasmuch as these infect with the poison of folly not only those of their own race but also those who associate with them, let them remain uncured, being incapacitated in sight, that most

<sup>6</sup> In *Leg. ad Gaium* 2, 557-8, Philo reproaches Caligula for not imitating the virtues of Dionysus, Heracles, and the Dioseuri whose titles he assumed (Conybeare).

<sup>7</sup> Plutarch in his essay on Isis (379 E) speaks of this animal worship, but he tries to defend the Egyptians by supposing that the various animals represent in symbolic fashion various attributes of the divine nature. Philo regards the worship of animals as more degraded than that of idols. He is followed by Justin Martyr and the Christian Apologists generally, but Clement of Alexandria rather defends the Egyptians as against the ancient Greeks (*Cohort. ad Gentes*, 325). (Condensed from Conybeare.)

necessary of all the senses. And I do not mean *physical* sight but that of the *soul* by which the true and the false are recognized.

But let the Therapeutic sect, being taught beforehand to look steadily at things, aim at the vision of the deity, and soar beyond the visible sun and never abandon this post which leads to perfect happiness. But those who devote themselves to this service neither from force of habit nor from the encouragement or appeal of others, but because they are overmastered by a heavenly love, are carried away just like the Bacchantes and Corybantes until they see what they long to see.<sup>8</sup> And then, because of their longing for the immortal and blessed life, considering that they have already finished their mortal existence, they leave their property to their sons and daughters, or even to their other relatives, cheerfully making them their heirs before the regular time. For it necessarily follows that those who have received from a free hand the wealth that sees should surrender the wealth that is blind to those who are still blinded in their minds.

The Greeks chant the praises of Anaxagoras and Democritus, because, smitten with a desire for philosophic study, they left their estates to be sheep-runs. I, myself, also admire these men who showed themselves thus superior to money. But how much better are those who did not permit their possessions to be devoured by animals, but have supplied the necessities of men, their relatives and friends, making them rich instead of poor? For the former was a heedless act, not to call it a "crazy" one, committed by men whom Greece delights to honor. But the latter was an act of sobriety, and one planned with extreme thoughtfulness. For what worse acts can enemies do than to ravage the crops and cut down the trees in the territory of their foes, in order that being hard-pressed by the lack of the necessities of life they may be forced to submit? And yet that is what Democritus and his ilk did to men of their own blood, bringing a fictitious (or artificial) want and poverty upon them, not thru malice aforethought, it may be, but thru lack of prudence and careful consideration of what was advantageous to others. How much better and more admirable are those who subject to no weaker impulse toward philosophy, but, preferring big-hearted generosity to carelessness, give away their property to please others, instead of destroying it,

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<sup>8</sup> Compare Matthew 5, 8: "Blessed are the pure in heart for they shall see God." Contemplation followed by ecstasy will carry one above all created things to the Creator himself. Plato says that "The highest object of knowledge, the Good or God, is only to be arrived at with difficulty, and only to be beheld at specially favorable moments." *Republic* vi, 506 E; vii, 517 B; *Timaeus*, 28 C; *Phaedrus* 248 A (Zeller, p. 223).



in order to help both themselves and others, and so have made others (M. 474) happy by their generous liberality and themselves by their philosophy. For anxiety about wealth and possessions uses up those who feel it, and it is a fine thing to husband one's time, since according to the physician Hippocrates "Life is short but art is long."<sup>9</sup> Homer also, it seems to me, darkly intimates the same in the *Iliad* at the opening of the thirteenth rhapsody,<sup>10</sup> in these verses: "And the Mysians, fierce fighters hand to hand, and the proud Hippemolgoi that drink mare's milk, and the Abioi, the most righteous of men" (Lang, Leaf, and Myer's version),—just as if anxiety and money-getting produce injustice because of inequality, while the opposite motive produces justice thru equality. In accordance with this equality the wealth that nature gives is well defined and surpasses that which exists in vain and empty fancies.

So when these people have given up their property,<sup>11</sup> not waiting to be caught by the bait of any other attraction, they flee without ever turning to look back, abandoning brothers, children, wives, parents, all the numerous hosts of kindred, fond associations, native lands in which they were born and reared, since association has a great drawing-power (like a windlass), and is most able to entice men.<sup>12</sup> And they change their residence not merely to another city, like those who beg their owners to sell them, unfortunate or worthless slaves that they are, who thus obtain for themselves a change of masters but not freedom from slavery; for every city, even the best governed, is filled full of indescribable uproar and ruin and confusion,

<sup>9</sup> These are the exact words of Hippocrates, but they were used by the great physician with reference to his own field of medicine. Later they became proverbial in a general sense.

<sup>10</sup> Rarely does Philo mention the exact place where a quotation is found. Some critics argue against the genuineness of this work of Philo from this passage, forgetting that the division of Homer into books was made by Zenodotus or Aristarchus, 250 years before Philo.

<sup>11</sup> In the first and second centuries A.D. it was a common thing to give away one's property when entering upon the religious life. Early Christians gave their property to bishops of the church or to the heads of orders. Sometimes the property was put into a common fund, as we know from Mark 10, 29 and Acts 4, 32-35.

<sup>12</sup> In his essay on the Decalogue (2, 181), Philo says it behooves the new convert to go away from his old surroundings entirely since friends and relatives would try to drag him back into paganism. Renunciation of home and friends was the keynote of early Christianity, and was strengthened by the firm belief that the second advent of Christ and the end of the world were near. Compare Jesus' own words in Matthew 19, 29: "And everyone that hath forsaken houses, or brethren, or sisters, or father, or mother, or wife, or children, or lands for my name's sake, shall receive a hundredfold, and shall inherit everlasting life."

which no one would put up with if once he were influenced by (M. 475) wisdom. But they make settlements for themselves outside the walls, in gardens<sup>13</sup> or in solitary places, seeking solitude not because of any harsh misanthropy which they have cultivated, but because they know that association with people totally dissimilar to themselves in character will be unprofitable and injurious to them.<sup>14</sup>

### III

Now this sect is to be found in many parts of the civilized world,<sup>15</sup> for it is right that both Greece and the land of the barbarians should share in the perfect good. But it is numerous in Egypt thruout each of the districts called Nomes, and particularly around Alexandria. And the best of people from every place, as if going to the native country of the Therapeutae, emigrate to a certain spot that is most convenient, which is situated above Lake Marea, upon a low-lying hill, being very well adapted to the purpose because of its safe position and its mild climate.<sup>16</sup> For the homesteads and villages

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<sup>13</sup> Compare John 18, 12 for a garden beyond the brook Kedron where Jesus went to be alone, and where certain traditions said that he was buried.

In Philo's *Life of Abraham* the evils of city life are pictured in a most vivid way, for he says: "Wickedness is everywhere and is therefore known to many; but goodness is rare, so that it is not noticed even by a few. Aimlessly doth the bad man hurry to the market-place and theaters and law-courts, to council-chambers and assemblies, to every kind of concourse and club. For he has given up his life to meddlesomeness, wagging his tongue in immoderate and endless and indiscriminate gossip, confounding and mixing up everything, truth with falsehood, and things which may be said with those which may not, private matters with public, and sacred with profane, and serious with ridiculous; all because he has never been taught that which in season is best, namely silence" (Conybeare's translation).

<sup>14</sup> Solitude and not asceticism is what is sought. Philo in his *De Profugis* ch. 4 (I, 549) holds out a nobler ideal for a young man of wealth than mere giving of it all away. He says: "See here, how thou canst act to escape from these struggles. Adapt thyself to live with the same things—I mean, not with the evil types of character, but with those things that engender them with honours, magistracies, silver, gold, possessions, colours (i.e. paintings), forms (i.e. statuary), diverse beautiful things. And when thou hast foregathered with them, then like a good artist stamp on these material things the noblest ideal and produce a perfect result worthy of praise" (Conybeare's translation).

<sup>15</sup> Similar societies, offshoots, no doubt, of the mother society of Alexandria, were found in Cyprus, Corinth, Tarsus, Colossae, Antioch, Rome, Smyrna, and in other places of the Mediterranean Basin.

<sup>16</sup> Since the Jewish quarter was in the northeastern part of the city, it would seem that the place of retreat would lie in that direction from Alexandria. Conybeare gives the probable location as on the low limestone

which are round about on every side afford it safety; and the constant breezes from the lake which opens into the sea, and from the sea itself which is close by, account for the mildness of the climate. The breezes from the sea are light, while those from the lake are heavy, and the mixture of the two produces a most healthful condition.

The houses of those who have gathered here are very cheap affairs, affording protection against the two most necessary things, against the heat of the sun and the chill of the air. Nor are the houses close together as they are in cities, for close proximity would be troublesome to those who seek solitude. Nor yet are they far apart because of the fellowship which they covet, and also in order that they may help one another should there be an attack of robbers.

In each house there is a sacred chapel which is called the sanctuary, and a private room where one may be alone.<sup>17</sup> To this they retire, and there alone they perform the mysteries of the holy life. Into this room they take nothing, no drink nor food, nor anything else that is necessary for the needs of the body, but having with them the laws and oracles that have come down thru the prophets, along with psalms and other books by which knowledge and piety are increased and perfected. Hence they ever keep the memory of God unceasingly before them, so that even in their dreams nothing ever presents itself to their minds other than the beauty of the divine virtues and powers.<sup>18</sup> Consequently many even talk in their dreams interpreting the glorious doctrines of their sacred philosophy.

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hills behind Nicopolis. Strabo says it was a good-sized place on the seashore about 30 stades from Alexandria. Lake Mareotis has been filled with seawater ever since British troops let in the water from Lake Aboukir in 1801. Strabo (c. 806) gives an account of the settlement of priests in the town of Heliopolis, which suggests the colony of the Therapeutae. Heliopolis was the On of the Old Testament and here is the oldest obelisk in the world.

In the convent at Heliopolis once lived Chaeremon, the traveling companion in Egypt of Aulus Gallus, and there were shown both the houses of the priests and the schools (*διατριβαί*) of Plato and Eudoxus.

<sup>17</sup> The word "sanctuary" is *σεμνείον*, which with *κοινόν* in 476, 23 means the public place for the Sabbath-day meeting. In Matthew 6, 6 it refers to private closet for prayer in a Jewish house. "The private room where one may be alone" is the word *μοναστήριον*, which later means a building or establishment for a single monk or hermit, or for a number of them, hence = monastery.

<sup>18</sup> Inspiration by dreams seems to be as old as mankind. In the *Iliad* and *Odyssey* we read often "Even a dream is from Zeus." By divine powers are meant the angels to whom God delegated the task of creating and governing the world. In Bunyan's *The Pilgrim's Progress* (Part II, p. 229, Harvard Classics), Christiana, after quoting Job 33, 14-15, says: "We need



Twice each day they are accustomed to pray, about dawn and toward evening. When the sun is rising they entreat God that the good day may be for them the true kind of a good day, and that their minds may be filled with heavenly light; and at sunset that their souls having been completely freed from the burden of sensations and sensible things may trace out truth as it exists in its own council-chamber and inner sanctuary. But the entire interval between morning and evening is devoted to the practice of philosophy; for taking up the reading of the Holy Scriptures, they philosophize and interpret allegorically their native code of laws, since they regard the words of the literal interpretation as symbols of a hidden nature revealed only in such figures of speech. They have, besides, writings of men of olden time, who having been the founders of the sect have left behind them many memorials of the real ideas wrapped (M. 476) up in these allegories.<sup>19</sup> These writings they use as examples, as it were, and so try to imitate their manner of persuasion. So they do not indulge in speculation only, but they, too, compose lyric songs and hymns to God in all varieties of meters and melodies which they write out as best they can in more dignified rhythms.

During six days, therefore, each person living in seclusion in the places called "monasteries", studies philosophy, never crossing the threshold, and not even looking out of the window. But on the seventh day,<sup>20</sup> they meet together as if for a common assembly, and sit down in order according to their ages with appropriate demeanor, keeping their hands inside their garments, their right hand between the chest

not, when abed, lie awake to talk with God. He can visit us while we sleep, and cause us then to hear his voice. Our heart oftentimes wakes when we sleep; and God can speak to that, either by words, by Proverbs, by Signs, and Similitudes, as well as if one was awake."

<sup>19</sup> Altho the Alexandrians believed in the inspiration of the Scriptures, they also adopted the Platonic maxim that "Nothing is to be believed which is unworthy of God." Here we have the underlying principle of Allegorism. Clement of Alexandria expresses it well in his *Homilies* II, 40: *πᾶν δεχθὲν ἡ γραφὴν κατὰ τοῦ θεοῦ ψεῦδος ἐστίν*. The initiated also refused to explain everything to others, and here comes in the doctrine of "Reserve" which is but the well-known "medicinal lie" of Plato.

<sup>20</sup> The Jewish observance of the Sabbath had spread and in Philo's day many others besides Jews had come to recognize its value and to respect its observance. Philo says in 2, 137: "Barbarians, Hellenes, Mainlanders, Islanders, races of the East and West, Europe, Asia, the entire inhabited world from end to end [observe Jewish law]. For who has not prized and honoured the Holy Sabbath, by granting respite from toil and a period of ease both to himself and to his neighbors, not to the free only but to the slaves, nay even to the beasts of burthen" (Conybeare's translation).

and chin, and their left hanging by their side.<sup>21</sup> Then the oldest and the one most experienced in their doctrines comes forward and addresses them with a steadfast gaze and steady voice, with good logic and sound reason, not making a display of his cleverness in speaking like the orators or the sophists of today, but having examined closely and interpreting carefully the exact meaning of the ideas, which interpretation does not then touch merely the tips of their ears but penetrates thru their sense of hearing into their soul and there remains permanently. All the others listen in silence, showing their assent only by glances of the eye or by nods of the head.

And this common holy place in which they gather on the seventh day is a double inclosure, divided into a place for the men and a place for the women. And this is so for the women also customarily make up part of the audience, having the same zeal and the same faith.<sup>22</sup> The wall between the rooms is built up three or four cubits in height above the floor like a breastwork (or partition), and the part from the top of this partition to the ceiling is left open, for two reasons, first that the modesty which is becoming in the female sex may be safeguarded; and, second, that their hearing of what is said may be easy since they sit within easy hearing distance and nothing can intercept the voice of the speaker.

#### IV

After having laid down self-control (or temperance) as a kind of foundation for the soul,<sup>23</sup> the speakers build upon this the other virtues. Not one of them would partake of food or drink before sunset since they think that philosophizing is consistent with the light, while the necessities of the body are worthy of darkness; whence they assign the one to the daytime, and the other to a brief portion only of the night. Some even forget about food for three days,<sup>24</sup> but these are the ones in whom a greater longing for knowledge is implanted. Some are so delighted and enjoy themselves so thoroly

<sup>21</sup> Conybeare says that he has observed Polish Jews on a Sabbath day preserve the same attitude in walking.

<sup>22</sup> The Essenes excluded women from communion and *συνάγιστα*, and they also in general frowned upon marriage. The Therapeutae freely married and gave equal rights to women in religious observances.

<sup>23</sup> In Xenophon, *Memorabilia* 1, 5, 4 we read: "Is it not the duty of every man to regard self-control to be the foundation of every virtue, and to make this the first consideration in his mind?"

<sup>24</sup> Philo in his *Life of Moses* 3, 2, 145 writes of the forty-day fast of Moses. The early Christians often fasted during Holy Week. Cf. Matthew 4, 1-11, and John 4, 32.

in being entertained by philosophy which supplies them so richly and abundantly with her doctrines that they can abstain from food for (M. 477) even twice that length of time, and after six days will scarcely taste even of necessary food, being accustomed, as they say the cicadas are,<sup>25</sup> to feed on the air, since their singing, I suppose, assuages their feeling of hunger.

They consider the seventh day to be a day most holy and to be kept as a festival, and so they have thought it worthy of special honor. On that day, after the care of the soul, they also anoint the body,<sup>26</sup> giving it complete rest, just as one might to one's cattle, from continuous labor. They eat no costly food, but simple bread, and, as a seasoning, salt, which the most dainty also further season by adding hyssop. Their drink is water from a spring.<sup>27</sup> The mistresses which nature has set over the human race, like hunger and thirst, they appease, offering, however, nothing to them by way of flattery, but only those useful things without which one cannot live. Therefore they eat simply that they may not be hungry,<sup>28</sup> and drink so as not to be thirsty, shunning satiety like an enemy and a conspirator against both soul and body.

Since there are two sorts of covering, clothing and dwelling, and since we have already spoken of their dwellings, telling how they are unadorned and home-made affairs, built only with a view to use, so we shall speak now of their clothing. It is likewise most inexpensive, serving as a protection against cold and heat,—in winter a thick cloak in place of a shaggy hide,<sup>29</sup> and in summer a sleeveless

<sup>25</sup> On the cicadas see Plato's *Phaedrus* 259 C: "And now they live again in the cicadas, and this is the return which the Muses make to them,—they hunger no more, neither thirst any more, but are always singing from the moment that they are born until they die." Read also the delightful Anacreontic, *To the Cicada* (H. 32), or the same translated by Thomas Moore, p. 27, No. xxxiv.

<sup>26</sup> The Essenes did not anoint themselves; the Stoics used ointments with moderation. The Jews were careful to avoid oils made by the Greeks.

<sup>27</sup> The region about Alexandria abounded in springs.

<sup>28</sup> Diogenes Laertius says of Socrates (2, 34): ἔλεγε, τοὺς μὲν ἄλλους ἀνθρώπους ζῆν, ὡς ἐσθίουεν· αὐτὸν δὲ ἐσθίειν, ἵνα ζῶη.

<sup>29</sup> Conybeare sums up the meaning of the passage thus: The Therapeutae scrupled to wear fur or skin as being a dead and hence unclean refuse of animals. Hence like the Essenes, the modern Hindoos, and the ancient Isiaci, they wore linen only. The modern Hindoo loses caste if he wears leather shoes. The new Benares water-works were boycotted by the natives because it was rumored that washers of leather were used in the taps.

Plutarch *De Ebriet.* 1, 369 insists on linen as the proper material of a priest's dress. The Therapeutae and the Pythagoreans were scrupulous about the purity of their linen garments.

jacket<sup>30</sup> made of linen. On the whole, they carry out their idea of simplicity, regarding the false as the beginning of pride, but truth the beginning of simplicity. They regard both truth and falsehood as a fountain, for from the false flow the manifold forms of evil, and from truth the abundance of good things both human and divine.

## V

I wish now to tell about their common gatherings, and their more cheerful means of relaxations in banquets contrasting them first with the symposia of others. For others, after they have filled themselves full of strong drink, as if they had drunk not wine but some deranging and maddening beverage, or if there is anything stronger yet to drive one out of his senses, they bawl aloud and rave after the manner of savage dogs, and attack and bite one another, and nibble their noses, ears, fingers, and other parts of their bodies, in order to prove the truth, it would seem, of the story of the Cyclops and the comrades of Odysseus. For in that story, the poet says that he ate gobbets of human flesh. But these do it in a more savage way than he, for he was taking vengeance upon those whom he regarded as enemies, while these devour companions and friends, and in some instances their own relatives, while at their own salt and table, perpetrating acts of hostility while at peace, like the acts of men in gymnastic contests counterfeiting you might say the proper practice like those who debase the legal coinage, becoming miserable wretches instead of wrestlers, for wretches is the only name that must be given to them.<sup>31</sup>

For what the Olympian athletes do with scientific skill in the (M. 478) stadia when sober, having all the Greeks as spectators and in the open light of day in order to gain victories and crowns, these wretches with counterfeit purpose do at their banquets by night and

<sup>30</sup> The *ἐξωμῆς* is the ordinary *χιτὼν ἑτερομάσχαλος* of the Greek workman and slave. The modern Poongye or Buddhist Friar of Burmah leaves his left shoulder bare (Conybeare).

<sup>31</sup> Athenaeus Bk. X, chap. 17, p. 420 E describes just such a banquet in Alexandria, saying: "But those of the present day who give entertainments, especially the inhabitants of the beautiful Alexandria, cry out, and make a noise, and curse the cup-bearer, the steward, and cook; and the slaves are all crying, being beaten with fists and driven about in every direction. And not only do the guests who are invited sup with great discomfort and annoyance, but even if there is a sacrifice going on, the God himself would veil his face and go away, leaving not only the house, but even the entire city, in which such things take place" (C. D. Yonge's translation). In *ἀθλητῶν ἀθλιοί*, "becoming miserable wretches instead of wrestlers", we have a common pun.



in darkness, like the drunken wine-soaked rascals they are, without science to the dishonor and insult and serious injury of those who are with them. And unless someone should come between them and part them like an umpire, they would fight on with greater fury, trying at once to murder and kill one another. For they do not suffer less than they inflict on others, altho they do not realize what is being done to them, those, that is, who dare to drink, not as the comic poet says to the injury of their neighbors only, but to their own as well.

Consequently those who came to the banquet a little while before, safe and sound and friendly to one another, a little later depart as foes and with their bodies mutilated. And some of them have need of lawyers and judges, others of doctors and those who can plaster them up, and of help from such as these.<sup>32</sup>

Others, who seem to be more restrained drinkers, drinking unmixed wine as if it were mandragora, bubble over, and supporting themselves on the left elbow and turning their necks to one side, vomit it up into basins, and then are overcome by deep sleep, neither knowing nor hearing anything further, like persons who have but a single sense and that the most slavish of them all—taste.

And I know of some persons who, when they are slightly drunk, before they become completely intoxicated (soaked in wine), try to arrange beforehand another banquet for the next day by voluntary contributions and subscriptions, regarding a part of their present pleasure to be the anticipation of getting drunk at a future time. So they live out their miserable lives in this way, passing their days homeless and hearthless, enemies of their parents and wives and children; enemies also of their native land, and above all their own worst enemies. For their besotted<sup>33</sup> and prodigal life is a menace to everyone.

## VI

Perhaps some may approve the style of banquet that is popular everywhere at the present time, on account of a preference for the Italian sumptuousness and luxury, which both the Greeks and Barbarians have carefully imitated, who make their preparations

<sup>32</sup> Aristophanes, *Wasps* 1252 ff., suggests the same thing: "By no means. Drinking is bad. From wine come both breaking of doors and the dealing of blows, and the throwing of stones; and then settling the bill, after your drunken headache."

<sup>33</sup> *ὑγρός* is found in Heraclitus in perhaps a similar sense. See Fragment (Bywater p. 73): *ὑγρὸν τὴν ψυχὴν ἔχων*; and (Fairbanks, 74-76): *αὐτὴ ψυχὴ σοφωτάτη καὶ ἀρίστη*, "The dry soul is wisest and best."

with a view to display rather than to good cheer. They use couches called triclina and circular couches adorned with tortoise-shell or ivory and other very expensive materials, most of which are further inlaid with precious stones. The couch-covers are of sea-purple with gold threads inwoven; others are brocaded with all sorts of flowers just to charm the eye. They use a vast number of drinking-cups arranged according to each separate variety. There are drinking-horns, and phials, and cylixes, and all other styles like the Thericlean cups, most artistically fashioned and perfectly made with relief work by men best versed in the art.<sup>34</sup>

And there are slaves to wait upon them, most graceful in form and (M. 479) most beautiful to gaze upon, who are present not so much for service but rather that by their appearance they may gratify the eyes of those who behold them. Of these some, who are still boys, pour the wine, while others—the bog boys—pour water—they themselves being carefully washed and well-groomed, their faces rubbed with cosmetics and their eyes penciled, and the hair of their heads carefully plaited and tightly bound up. For they have thick, long, hair, either not cut at all, or with their front locks only trimmed at the ends so as to make them of equal length, and to make an exact figure of a neatly curving line.<sup>35</sup>

They are clothed in tunics as fine as spider webs, and perfectly white, carefully tucked up high thru their belts. In front they fall just below the knees, and behind to the calves of the leg. And they draw together each side of the garment and fasten them with curly bows of ribbon along the line of their joining. And thus they let the folds dangle down obliquely, the hollows of the sides being puffed and broadened out.<sup>36</sup> Others, young men on whose chins the first

<sup>34</sup> Roman luxury would pass naturally to Alexandria first of all. Strabo calls Alexandria the μέγιστον ἐμπόριον τῆς οἰκουμένης. It was the distributing point for all the products of China, India, and Ethiopia. Tacitus—*Annals* 3, chaps. 52–55, tells of the luxuries of Rome and Alexandria and of the efforts of the Emperor Tiberius to put a curb upon them. See also Athenaeus Bk. vi, chaps. 107, 108 (274 E).

<sup>35</sup> I have followed Conybeare closely in this difficult passage. The hair, according to the above translation, would form a rounded fringe over the forehead. Dio Chrys. *Or.* II says that the dandies of his day affected this style.

<sup>36</sup> Again Conybeare is my guide in this difficult passage. He says: "At an ordinary banquet the slaves who waited drew up the lower part of the χιτὼν through the girdle over which it hung in folds. In the luxurious banquets the slaves are ἐπαναξωσάμενοι, i.e. girt up very high to give them facility in moving about with the dishes. In the simple banquets of the Therapeutae, described later, the χιτωνίσκοι of the deacons were allowed to flow down to their feet, thus avoiding any appearance of a slavish garb."

beard of youth is beginning to bloom, wait in relays. Shortly before they were the playthings of their lovers, and are carefully prepared with too exceeding daintiness for any more serious service. These are, as it were, just an exhibition of the wealth of the entertainer, as those who are experienced know, and they rather, in truth, show their vulgar extravagance.

Besides this there are all the different varieties of pastry and dainties and sweetmeats, over which bakers and cooks have labored, considering not how to please the taste, which is a necessary thing, but also to satisfy the sight by their delicacy. Seven tables<sup>37</sup> and even more are brought in filled with all kinds of products which the land and sea and rivers and air produce, all carefully selected and in prime condition; things of earth and water and air, of which each one excels both in its preparation and in its garnishing so that no form of product may be lacking of all those found in nature. Finally, dishes are brought in loaded with nuts and apples, not to mention those things which are kept for the revels, and such as we call dessert.

Then some of the tables are carried out empty because of the insatiate appetites of those present, who, gorging themselves like sea-gulls, gobble up everything even to gnawing the very bones, while other courses they leave half eaten after spoiling them by picking them over. And then, when they are utterly tired out, with bellies filled even to their throats, tho their lust for food is still unsatisfied, weary of eating any more, they crane their necks this

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<sup>37</sup>Suetonius, *Augustus* 74, gives three or at most six tables, or courses, for the different courses were served from small tables brought in and placed before the couches. Athenaeus Bk. XII. ch. 69 (574) has the following interesting passage. He says that Lycon the Peripatetic "used to entertain his friends at banquets with excessive arrogance and extravagance. For besides the music which was provided at his entertainments, and the silver plate and coverlets which were exhibited, all the rest of the preparation and the superb character of the dishes was such, and the multitude of tables and cooks was so great, that many people were actually alarmed, and, tho they wished to be admitted into his school, shrunk back, fearing to enter, as into a badly governed state, which was always burdening her citizens with liturgies and other expensive offices " (C. D. Yonge's translation). In contrast to this, Athenaeus then goes on to tell of monthly banquets in honor of the Muses instituted by Plato and Speusippus in the Academy; "not in order that people might dwell upon the pleasures of the table from daybreak, or for the sake of getting drunk, but in order that men might appear to honor the Deity and to associate with one another in a natural manner, and chiefly with a view to natural relaxation and conversation" (C. D. Yonge's translation). After a meal of this kind with Plato, it is reported that a certain general, Timotheus remarked, "With such company one need fear no headaches tomorrow." (See Zeller *Plato and the Older Academy*, p. 28, n. 59.)

way and that and fairly lick up things with their eyes and nostrils,—with their eyes taking in the richness and the quantity of eatables, and with their nostrils drinking in the sweet savor that steams up from them. Then when they are completely surfeited with both the sight and the smell, they begin to urge others to eat, praising extravagantly the preparations for the feast and the host for spending so lavishly.

But why should I prolong the story of such doings as these which are condemned now by many people of the more moderate sort? Such luxuries cause the passions to break out, while the lessening of (M. 480) lusts is the thing to be desired. For one may well pray for thirst and hunger, things usually most deprecated, rather than for the excessive waste of food and drink in banquets such as these.

## VII

Of the banquets in Greece, the most famous and the most notable are those two at which Socrates was present. One of these was at the house of Callias, and was held to celebrate the winning of the crown of victory by Autolycus. The other was at the home of Agathon. These were banquets which men like Xenophon and Plato, philosophers in character and language, thought worthy of commemoration. For they described them as events worth remembering, which they surmised future generations might make use of as models of the proper management of banquets. But yet even these will appear laughable when compared with the banquets of our Therapeutae who have embraced the contemplative life. Each of the banquets just mentioned has its own kind of attractions, but Xenophon's banquet is more human, for flute-girls and dancers and conjurors and professional jokers, who pride themselves on their ability to be funny and to amuse people, are introduced. And there are present also certain other features which induce hilarity.

But the Platonic *Symposium* is almost entirely concerned with love, not merely of men madly in love with women, nor of women with men, for these passions pay tribute to the laws of nature, but of men for males who differ only in respect to age. For if anything in this dialog seems to be presented in a dainty manner concerning love and heavenly Aphrodite, it has been dragged in bodily for the sake of cleverness. But the greater part of the dialog is entirely taken up with common and vulgar love<sup>38</sup> which robs one of manhood—that

<sup>38</sup>Athenaeus also condemns Plato's *Symposium* for introducing the same subject, for we read in Bk. XI, ch. 118 (508): "And as to the disquisitions



virtue most useful for life whether in war or in peace, and that which engenders in the sons of men the female disease and makes them into men-women, whereas they should be closely welded together in all the pursuits that make for manliness.

So having outraged the youth of boys and having reduced them to the class and condition of "lights of love", it injures the lovers also in most essential particulars—body, mind, and estate. For it is necessarily true that the mind of the boy-lover must be kept on the stretch toward his favorite, looking intently to this alone and blind to all other interests, both private and public. It also follows that his body must be wasted away by lust, especially if he fail to obtain satisfaction. And his estate must be lessened in two ways, both from his neglect and from what he squanders upon the object of his love.

And a still greater evil is engendered that affects all the people, causing depopulation of cities and scarcity of the better sort of man, and barrenness and unfruitfulness, since they imitate those who are (M. 481) inexperienced in the cultivation of the soil, who sow seed not upon deep-soiled land of the plain but rather upon salty marshes, or upon stony and hard-trodden places, which are not fitted by nature to grow anything, and only destroy the seed cast upon them.<sup>39</sup>

I pass over in silence such fabrications in myths as creatures with two bodies, which originally having grown together by causes that made them unite, later become disunited like parts of creatures that once had come together merely, when the attractive force is dissolved that once made them unite. All these things are very seductive, being able by their very strangeness of conception to catch the attention, but which the followers of Moses by reason of their great superiority may well despise, having learned from early youth to love the truth, and so living on incapable of being deceived.

## VIII

But since the banquets most widely celebrated are filled with such nonsense, having in themselves their own condemnation, if anyone should be willing to examine them not from the reputation and the

which Plato enters into about man, we also seek in his arguments for what we do not find. But what we do find are banquets, and conversations about love, and other very unseemly harangues, which he composed with great contempt for those who were to read them, as the greater part of his pupils were of a tyrannical and calumnious disposition" (C. D. Yonge's translation).

<sup>39</sup> If Plato offends in the *Symposium* it was because of catering to some of his hearers. We may be sure that his real feeling on the subject is expressed in the *Laws* 8, 838 B. where he condemns all such practices as *μυδαμῶς ὄσια, θεομισῆ δὲ καὶ αἰσχρῶν αἰσχιστα*.

report that has been spread abroad regarding them as being most successful affairs—I shall now set in array against them the banquets of those who have devoted their own lives and their very selves to the knowledge and contemplation of the realities of nature according to the most holy precepts of the prophet Moses.

In the first place these gather every seven weeks, revering not only the simple week of seven days but also its power as well. For they know that it is holy and ever-virgin. And this is a preliminary to the greatest festival which by lot is assigned to the fiftieth day, because the number fifty is the most holy and natural of numbers, because it is composed of the power of the right-angled triangle, which is the source of the origin of the whole universe.<sup>40</sup>

Therefore, when they have met together, clad in white garments and beaming with joy, yet with the highest dignity, when the signal is given by the one who is to perform the service for the day (for it is customary to designate as Ephemereutae those who engage in such service), before they recline they take their places in rows in well-ordered fashion, and raise both their eyes and their hands to heaven—their eyes because they have been taught to see what is right to look at, and their hands because they are clean of all unjust gains, being polluted by no pretense of things that make for their own private advantage—they then pray God that the banquet may be well-pleasing in his sight and acceptable. And after the prayers, the elders lie down following the order of their election. For they regard as elders not those of many years and those who are merely old, but, on the other hand, count these still more as infants who have been late to attach themselves to this sect. But they call those elders who from early youth have grown up and reached their acme (M. 482) in the contemplative branch of philosophy, which is indeed the most beautiful and the most divine part of it.

The women also banquet with the men, the most of whom, tho old, are still virgins, having kept their purity not from necessity like some of the priestesses among the Greeks,<sup>41</sup> but rather thru

<sup>40</sup> Conybeare thus explains the whole passage: "Let the sides of a right-angled triangle be in length respectively 3, 4, and 5; then the square of the sides which contain the right angle equal the square on the hypotenuse, that is to say,  $9 + 16 = 25$ . Also the sum of the three squares,  $9 + 16 + 25 = 50$ . This sum of the squares Philo calls the *δύναμις τοῦ ὀρθογωνίου τριγώνου*."

<sup>41</sup> This is true of the priestess of the Pythian Apollo, and of certain ones in the service of Heracles. Chastity was considered essential in the progress toward perfection both among the Therapeutae and the early Christians. Among some even lawful marriage was condemned. Athenagoras. *Apology*, chap. 33, speaks of old men and women, unmarried, living in the hope of closer communion with God. The custom was doubtless common among certain sects of the Jews before the days of Christianity.

their own choice, because of their zeal and eagerness for learning, in which being eager to pass their lives they despise the pleasures of the body. They are desirous not of a mortal progeny but of an immortal, which only the soul that loves God is able to produce of itself, since the Father has sown in it rays of light perceptible by the mind alone, by which it will be able to contemplate the doctrines of wisdom.<sup>42</sup>

## IX

They lie on the couches in divided lines, the men by themselves on the right, and the women by themselves on the left. If anyone imagines that they have prepared couches, even if not expensive ones, at least rather soft ones suitable for persons who like themselves are of noble birth, and refined, and cultivators of philosophy, he is mistaken. For the beds are of any material that comes handy, on which are laid very cheap floor-mats made of the native papyrus, raised a little under the elbows that they may lean upon them. For the Laconian rigor of life is relaxed slightly, and always and everywhere they practice a contentedness with their food that befits a free man, resenting with all their might the enticements of pleasure.<sup>43</sup>

Nor are they waited upon by slaves, because they regard the possession of slaves as entirely contrary to nature. For nature has created all men free, but the injustice and greed of some, jealous

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<sup>42</sup>In common with many others of his day, Philo believed that a woman might conceive and bring forth *διὰ τοῦ θεοῦ* and without a mortal husband. Among the Egyptians, Isis was said to have conceived thru the ears; among the Greeks Danaë thru a stream of gold which would mean the sunlight; and in early art the Virgin Mary is pictured surrounded with rays of light. Regarding the birth of Plato, Conybeare has the following interesting passage: "As the master of those who aspired to a life of pure reason, to which the body and the senses should contribute little or nothing, Plato was himself believed to have been born of a virgin mother, who conceived him by the god Apollo. Such a myth grew up quite naturally about Plato, who is for a superficial reader the most abstract of thinkers; just as about Aristotle it could never have arisen; for he, tho really the greatest of idealists, is yet at first sight the most matter-of-fact of thinkers" (Conybeare, *Excursus*, p. 31, 317).

<sup>43</sup>Conybeare makes the whole clear by the following note which is given in condensed form: They lie down in two rows, the women on one side of the table, the men on the other, leaning on the left elbow with a cushion under the arm to raise them up conveniently. The person lying to the right of another was said to recline in his bosom (*ἀνακείσθαι ἐν τῷ κόλπῳ*). So in John 13, 23 the meaning is that John as the beloved disciple reclined next to Jesus

Simple banquets like the above are described in Plato's *Republic* ii, p. 372 B. Plutarch, *Lycurgus* 16, 50 C tells how Spartan boys had to cut the rushes to make their own beds.

for the inequality which is the beginning of evil, has yoked (and so, subdued), and then attached the power of the weaker to the stronger.

In this holy banquet then, as I said, there is no slave, but free men serve the guests, performing the office of servants not from compulsion nor executing orders, but of their own free will with eagerness, and zeal anticipating orders. Nor is it any and every free man who is appointed to these services, but novices selected from their order with all care according to merit, acting in the manner in which noble and well-born youths should act, and those who aim at the height of virtue. These, like genuine sons, wait upon their fathers and mothers in friendly rivalry and cheerfulness, regarding these as their common parents, and as more closely related to them than blood relatives; since to men who have the right ideas nothing is more nearly related to them than true righteousness.<sup>44</sup>

And they come in to serve without girdles and with their tunics (M. 483) let down to avoid any resemblance of a slavish garb. I know that some will laugh when they hear about this banquet, but those who laugh will be those who do what is worthy rather of tears and dirges!—wine is not introduced into the banquet on these days, but the most translucently clear water, cold for the majority, but hot for those of the elders accustomed to live daintily. And the table is free from bloody food (i.e. animal food), but on the table is bread for nourishment, and salt for a relish, to which hyssop is added sometimes as a seasoning, because of those accustomed to luxuries. For as good sense induces the priests to offer wineless sacrifices, so it leads these to live soberly. For wine is the drug of folly, and costly dainties excite passion which is the most insatiable of wild beasts.

## X

So much for the preliminaries of the banquet. Now after the banqueters have taken their places on the couches in the order in which I have explained, and when those who are to wait upon them have taken their stand in order ready for service, their leader when silence has become general—but when is it not? one might ask—but now more than ever is it true, so that one does not even utter a squeak

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<sup>44</sup>Compare Matthew 12, 47: "Then one said unto him, Behold, thy mother and thy brethren stand without, desiring to speak with thee. But he answered and said unto them that told him, Who is my mother? and who are my brethren? And he stretched forth his hand toward his disciples, and said, Behold my mother and my brethren! For whosoever shall do the will of my Father which is in heaven, the same is my brother, and sister and mother."



or draw a loud breath,—their leader then, as I said, discusses some passage from the Holy Scriptures, or answers some question raised by another, thinking nothing about display, for he is not straining after reputation for cleverness in speaking, but only longs to understand some point most accurately, and when he has seen a thing himself not begrudging others if they do not see the thing with equal clearness, but have at least a similar desire to learn. And so he employs a slower method than usual of teaching, lingering over a point now and then and going slowly with frequent recapitulations, and thus able to engrave the thoughts deep in their souls. For the minds of the listeners being unable to keep pace with the interpretation of one who speaks rapidly and breathlessly would fall behind and fail to grasp what is said. But the listeners fix their attention upon the speaker, and, remaining in one and the same attitude, listen to him intently, showing their understanding and comprehension by nods and looks, and their praise of the speaker by their cheerful countenance and by the gentle turning of their faces, while they show their perplexity by a very gentle movement of the head, or by the finger-tip of their right hand. The youths who stand about the tables also give heed to what is said no less than those reclining on the couches.

The interpretation of the Holy Scriptures is by explaining the meaning hidden in allegorical forms. For the whole body of the law appears to these men to be like a living animal, whose body is the literal commands (or precepts), and the unseen meaning lying within the words is the soul. And in this thought the rational soul begins especially to contemplate what belongs properly to itself, beholding as if in a mirror the extraordinary beauties of the ideas conveyed in the names. So on the one hand it unfolds and reveals the (M. 484) symbols, and, on the other hand, it brings naked to the light of day the real meaning to such who are able by a little exercise of memory to see what is unseen by means of what is seen.<sup>45</sup>

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<sup>45</sup> Heraclitus, Xenophanes, and Plato objected to immoral stories found in Homer and Hesiod. In Fragment 119 (Fairbanks) Heraclitus says: "Homer deserved to be cast out of the lists and flogged, and Archilochus likewise." Xenophanes (Frag. 7, Fairbanks) reads: "Homer and Hesiod attributed to the gods all things which are disreputable and worthy of blame when done by men; and they told of them many lawless deeds, stealing, adultery, and deception of each other."

Of Plato, Zeller says (p. 511): "He will have the framing of myths and the exercise of art in general placed under the guidance of public authorities, —and all that is not in accordance with the moral aims of the State ejected. He forbids in the *Republic* all myths which relate dishonorable things concerning the gods and heroes. He wholly banishes from the State dramatic

So, after the president seems to have spoken long enough, and when the discourse seems to have done justice in a satisfactory way to the ideas presented by its relevance and pertinence, while as listeners the others seem to have responded adequately by their attentiveness then, as if all were well pleased, there is applause, but restricted to three rounds only.<sup>46</sup> And then someone rises and sings a hymn composed in honor of God, either a new one which he himself has written, or some old one of the ancient poets. For they have bequeathed to posterity many poems and songs in iambic trimeter verse, processional songs, hymns for libation and altar, stasima, chorals, all well-measured in strophes and antistrophes.

And after him others rise in their places in proper order, while all the rest listen in profound silence as they sing, except when it is necessary for everyone to join in the responses and to sing the solemn refrains.<sup>47</sup> For then all, both men and women, join in the singing.

But when each person has finished his hymn, the young men bring in the table mentioned a little above, on which is the most holy food, leavened bread with a seasoning of salt with which hyssop has been mixed out of respect for the sacred table which is placed in the holy outer sanctuary of the temple.<sup>48</sup> For on this latter table are placed bread and salt without flavoring. The bread, that is, is unleavened and the salt is unmixed (with hyssop). For it is fitting that

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poetry, and tho he permits in the Epics the imitation of the speeches of other persons as well as simple narration, it is only in cases where these speeches would serve as a moral exemplar. So that, as he says, nothing would remain of the whole Art of Poetry but hymns to the gods and praises of famous men."

Many of the ancient Greeks avoided the difficulty concerning the wicked and immoral myths by the allegorizing method, as did the Jews in interpreting objectionable passages in the Old Testament.

<sup>46</sup>This rendering follows Conybeare's restoration of the text from the Armenian version. In the early Christian church applause seems to have been permitted, but sometimes it may have been restricted as seems to be the case here.

<sup>47</sup>For such a refrain compare "for his mercy endureth forever" so frequent in the Psalms. Perhaps the exclamation "alleluia" or "amen" would come under the word "response".

<sup>48</sup>Compare Matthew 12, 3: "Have ye not read what David did . . . how he entered into the house of God and did eat the shewbread, which it was not lawful for him to eat, neither for them that were with him, but only for the priests?"

Conybeare has this interesting historical note: "Since the shewbread was offered only in the temple at Jerusalem and not in synagogues at all, either before or after the destruction of the temple by Titus, this reference to the shewbread must have been penned before the latter event."

the simplest and the least mixed (or purest) things should be allotted to the highest class of the priests as a prize for their service, while the rest should aspire to *similar* things to be sure, but not to the *same* things that their betters may retain their privilege.<sup>49</sup>

## XI

But after the dinner they celebrate the sacred all-night festival. This night festival is celebrated in the following manner. They all stand up in a body, and in the midst of the banquet at first two (M. 485) choruses are formed, one of men, the other of women. A guide and leader of each chorus is chosen, a man who is both most highly esteemed and most suitable for the place. Then they sing hymns<sup>50</sup> composed in honor of God in many meters and melodies, now singing in concert, now moving their hands and dancing to the time of antiphonal harmonies, and crying out the name of God, now moving in procession, now standing still, like the strophes and antistrophes in a chorus.

Then when each chorus has had its fill singing and dancing separately, then as if it were in the Bacchic revels, having drunk deep of the pure wine of divine love, they join forces and one chorus

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<sup>49</sup>This banquet of the Therapeutae which Philo has been describing must have been celebrated on the eve of the Day of Pentecost. In the next chapter he refers to this greatest day, but he does not say explicitly that they met together a second time. The Feast of Pentecost commemorated Moses' receiving of the Law on Mt. Sinai, and as it was the season of harvest and vintage it was a feast of rejoicing when, as was natural, some may have overindulged. So the Therapeutae were careful to avoid all excesses, but as Philo says in 481, 30 they were not long-faced or lugubrious but of cheerful countenance (*φαιδροί*). The Therapeutae also observed the Feast of Tabernacles. Some have thought Philo was describing the Passover, but the Passover was not a *κοινὴ σίνωδος* (common assembly) but was celebrated privately at home. Nor was Philo describing the Easter festival, as others have thought, following Eusebius, who regarded the Therapeutae as early Christians.

<sup>50</sup>Conybeare's note explains the passage thus: "The hymns which the Therapeutae sang after their meal, in many measures and strains, included the great Hallel (i.e. Psalms 113-118). This Hallel was sung, so we learn from the *Talmud*, on the first day of Pentecost. The dance of the Therapeutae was intended to celebrate the deliverance of Israel out of the land of Egypt. So in Deuteronomy 16, 12, in connection with Pentecost, we read "And thou shalt remember that thou wast a bondman in the land of Egypt; and thou shalt observe and do these statutes." In Matthew 26, 30, the Last Supper closed with the singing of a hymn. Dancing had to be restricted and even forbidden among Christians in the fourth century. The Jews always danced at festivals, and during the first night of the Feast of Tabernacles men and women danced in the court of the temple (Conybeare).

is formed of the two, in imitation of the ancient chorus organized at the Red Sea, to celebrate the miracles that were wrought there. For, by the decree of God, the sea became a means of safety to the one side, but a means of utter destruction to the other. For the sea being rent asunder was forced back by violent recoil, and solid walls, as it were, were made on either side of them, and the intervening space was cut and widened into a broad, level, and dry road for all, thru which the people marched over to the opposite shore, and were brought in safety to the higher ground. Then by the returning waters coming back in and pouring in on this side and on that on what had been dry ground but a little while before, those of the enemy who pursued them were overwhelmed and so perished.

So when the people saw and experienced this which was an act beyond reason and thought and hope, being filled with divine inspiration, both men and women alike, forming one single chorus, sang hymns of thanksgiving to God, the Savior, Moses the prophet leading the men, and Miriam the prophetess leading the women.

In the very closest imitation, therefore, of this chorus, the company of the Therapeutae, both men and women, form a harmonious and truly musical symphony, the shrill voices of the women blending with the deeper tones of the men in corresponding and antiphonal songs. Very beautiful are the ideas and very beautiful the expression of them, and the chorus itself is impressive. The end and aim of the ideas and of the words and of the chorus is holiness.

So being intoxicated until dawn with this beautiful kind of intoxication, not with heavy heads or sleepy eyes, but feeling even more wide-awake than when they came to the banquet, they stand up and turn their eyes and their whole body toward the East. And when they see the sun rising, they raise their hands toward the heaven, and pray for a fair day and truth and keenness of understanding. And after the prayers each one returns to his own separate sanctuary with the purpose of dealing again in philosophy and cultivating speculation.<sup>51</sup>

So much, then, have I to say concerning those who are called Therapeutae, who have embraced the contemplation of nature, and who have lived in it and in the soul alone. Truly are they citizens<sup>52</sup>

<sup>51</sup> Conybeare remarks that "As the hands of the Therapeutae were *καθαραὶ λημμάτων* their philosophy was the only 'trade' they had." The word for cultivation here is *γεωργήσοντες*, which of course refers primarily to tilling the soil. The Stoics and Church Fathers use it in the same figurative sense as here.

<sup>52</sup> The early Christians from Paul onwards adopted the Stoic's doctrine. Cf. Paul, Philippians 3, 20: *ἡμῶν γὰρ τὸ πολίτευμα ἐν οὐρανοῖς ἐπάρχει*, for our citizenship is in heaven."



of heaven and of the universe, and truly acceptable to the father and creator of the world because of their virtue which has won them his love, and has gained for them a most fitting reward for their goodness—a thing better than all merely good fortune, and leading them in anticipation to the very summit of happiness.

## Philo Judaeus and His Religious Ideas

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FROM the best authorities we learn that Philo, who is commonly called Philo Judaeus, was born in Alexandria, Egypt, sometime between 20 and 10 B.C., and that he spent most of his life there. His father was a farmer of the taxes for the district east of the Nile. In the year 40 A.D. Philo headed an embassy that went to Rome to petition the Emperor Caligula not to demand divine honors and worship from the Jews. This he tells us himself in his *De Legatione ad Gaium*. We do not know the date or place of his death.

Philo is the most important representative of the Hellenized Jews. It will be remembered that the Jews of the Diaspora, scattered as they were over the world, adopted in most cases the language of the people among whom they settled. These who lived among the Greeks especially gave up their native tongue, used the Greek language, and became saturated with Greek culture. Still they very largely clung to their Jewish faith and practices. This Hellenic Judaism reached its highest development in and around Alexandria. According to Philo, the Jews in Egypt numbered fully a million people, and in Alexandria two of the five quarters of the city were given over to them. Egypt was governed at this time by a governor sent from Rome, but both the Greek and the Hebrew citizens had considerable freedom and enjoyed certain political rights. Doubtless the shrewd Jews had coined money in the lucrative wheat trade, in buying and selling papyrus, in banking, and money lending.

One of the most important events in the history of the Alexandrian Jews was, of course, the translation of the Hebrew Scriptures into Greek in the version called the Septuagint. But long before this, in the second century B.C., we have the great philosophical commentary on the Pentateuch by Aristobulus, in which the allegorizing method of interpretation was employed and an effort was made to make the Jewish Scriptures attractive to the Greeks. The Greeks had always been familiar with such interpretation of Homer and Hesiod. Both of these purposes, to interpret allegorically and to attract the Greeks, were present in Philo, who may in fact be called the chief exponent of the allegorizing method applied to the Hebrew scriptures. He had the missionary spirit, seeking to win Greeks and other gentiles to the true religion of the Jews. He is familiar with Greek philosophy, especially Heraclitus, the Stoics, Pythagoreans, and above all with Plato. His language is largely influenced by Plato, and his philosophy is

fundamentally Greek, colored of course by Hebraism. One can no more understand and appreciate Philo than Plato without being somewhat of a mystic and in sympathy with the allegorizing method.

Philo believed implicitly in the Law as handed down by Moses in the Pentateuch, and wherever similar ideas are found in Greek philosophy, he with other Jews believed they had been borrowed from the Hebrews. They adopted Plato as their own, calling him the Moses who spoke Attic Greek (Μωϋσῆς ἀττικίζων). Philo is always trying to harmonize Moses and Plato. Religion is Philo's first concern, and here he combats especially the anthropomorphism so common in most Greek writers and in many rabbinical commentators on the Old Testament. Like Xenophanes in an earlier age, Philo insists that God is a spirit and must be worshipped as such. Compare John 4, 24, "God is a Spirit; and they that worship him must worship him in spirit and in truth." Philo even hesitates to give God a name, for he says: "Names are symbols of created things; do not look for a name for Him who is uncreated." But Philo stops before he pushes his argument to pure negation of all qualities and attributes, and thus he remains more human if less logical.

God, according to his idea, did not create the world himself, but delegated his creative energy to certain ministers called Powers, which in a way are identical with Angels, or with the Logoi of the Stoics, or even with the Platonic Ideas. They are the Thoughts of God. These Angels are governed by both the Goodness and the Justice of God. The backbone of all of Philo's philosophy is the doctrine of the Logos. This was not his invention, for it is found in the Stoics, and even as early as Heraclitus. The reason why Philo preferred it to the Platonic Idea is because of the frequent use of the expression "The Word of God" in the Hebrew Scriptures. Besides, its vagueness could be interpreted as "word" merely, or "reason", "plan", "system", "idea", etc. Faust had the same difficulty in finding just the appropriate translation for λόγος.<sup>1</sup>

<sup>1</sup>The significance of the λόγος in the world's thought is admirably expressed in the following quotation from W. P. Montague ("The Antinomy and Logical Theory", in the *Columbia University Studies in the History of Ideas*, p. 236): "Many who failed to see the concrete flux of Heraclitus have seen in one form or another his fluxless Logos. Parmenides saw only its shadow, the mere generic character of abstract being and permanence, projected into the abyss as a dark and homogeneous sphere. For the gorgeous mind of Plato the Logos was reflected above the sky as a rainbow of moral beauties and creative mystic powers. To Aquinas and Leibnitz it seemed as the omnipresent intellect of an eternal God. By the transcendental Germans, it was taken for the presupposition of the sensible world, which it was, and then mistaken for the grandiose structure of their egos, which it certainly was not."

This Logos is related to God, to his Powers, and to Man. Related to God, it stands for his Wisdom; related to the Powers, it is the Creator and Governor of the Universe; related to man, it is the go-between, mediator, high priest, and saviour. One cannot know God, but one can approach nearer and nearer to him thru Faith, Hope, Discipline, and Service. Here we are reminded of Plato's ideal of "a pattern in heaven" (*παράδειγμα ἐν οὐρανῷ*), and of man's duty "to put on the immortal as far as in one lies" (*ἐφ' ὅσον ἐνδέχεται ἀθανάτισθαι*), and of "assimilation to God" (*ὁμοίωσις τῷ Θεῷ*).

God is more and more revealed to us by experience in life thru fear of his Justice first, and later thru love of his Goodness. Only a few attain to close knowledge of God, and Philo himself claimed to have experienced certain moments of ecstasy when he lost himself completely, was oblivious of his surroundings, and unconscious of what he said or wrote. Here, of course, he was influenced by the visions recounted in Scripture.

As Montefiore says, we may speculate upon the slight effect Philo made upon the development of Judaism, but it is evident that he did affect Christian theology quite definitely. The influence of the Logos is apparent, for example, in John, in James, and in Paul's Epistle to the Hebrews. The Logos idea also aided in the conception of a division in the Godhead. The Holy Spirit as the third person of the Trinity came later, to be sure, but the Father and the Logos helped to develop the idea of Duality, not that the Logos in Philo is the Messiah or the Christ.

Philo also helped to inculcate the idea that the Kingdom of God is something within us here and now, and not an external earthly realm, or a future Heaven. The rewards of a good life are holiness and a present vision and apprehension of God; the punishment of a bad life is in the realization that one is wicked and shut out from God's presence. All this is elevating and opposed to the vulgar idea of rewards and punishments in another world. It also combats the notion that heaven can be purchased by self-inflicted sufferings here, or, in other words, it opposes asceticism as a cult.

To know God is Philo's supreme aim. Altho he seeks this knowledge by the pathway of metaphysics, he knows perfectly well that "only the pure in heart shall see God", and

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The realistic or anti-Darwinian logicians of today perceive it less picturesquely, and more, perhaps, as Heraclitus himself. To them it is an objective and self-subsistent loom of invariant law, on which the ever-changing fabrics of evolving nature are perpetually woven."

Philo certainly imitated Plato's "creative mystic powers".



that a heaven-sent ecstasy is all that can give one even a fleeting vision of God—like Moses on the Mount or before the burning bush. Recognizing that finite mind cannot grasp the infinite God, he yet proceeds as if the unknowable were knowable.<sup>2</sup> How he does this is thru the Pentateuch, in which he believes is *all* truth. If *all* truth is there, then *God* is there. But in the Pentateuch the statements about God are colored by finite minds and can only present God as a superman. Philo's task is to try and strip off this human disguise as far as possible and to arrive at a close approximation of God.

One of the first elements which he recognizes in God is his omnipresence. This is shown in the account of the Garden of Eden first, and in many passages later. Closely allied to this ubiquity is God's immanence. Admitting that God is above and outside his creation, and is superior to time and space so that past and future time are all present time with God, yet Philo says that God pervades all creation. Drummond says on this point: "Although God remains immovable in his omnipresence, yet his power may be manifested with varying intensity in different places, just as he is said to dwell in the purified souls as in a house, because his watchful providence is most conspicuous there." The simplest way to represent this idea of time and space is to say merely "God is."

Again, God is all-sufficient within himself (*ἀνταρχέστατος ἑαυτῷ*), (I, 582). While men stand in need of things, God needs nothing.

God is also perfect peace. With Heraclitus, Philo holds that everything is in constant flux and flow (*πάντα ῥεῖ*), and that strife is a natural and necessary condition of progress, but that God changes not and is perfect peace. Here we note a similarity with Aristotle's thought about God which he arrived at thru an ecstasy of contemplation. Aristotle made God simply thought reacting upon thought (*νόησις νοήσεως*), which would mean that God has little or nothing to do with his creation or creatures. Philo does not go so far as this, for he stresses also God's goodness which makes him take a personal interest in what he has made. He creates constantly, or as Philo expresses it: "God never ceases to create,

<sup>2</sup> Philo's arguments remind us on the one hand of Spinoza's pantheistic argument for the existence of God, and on the other of Berkeley's dilemma in trying to recognize God as creator and conservator of nature, while realizing that nature is absolute and mathematical. Philo is at times almost as troubled as the good bishop by the seeming impossibility of reconciling these two ideas.

but as it is the property of fire to burn, and of snow to cause cold, so also it is the property of God to create (I, 44).<sup>3</sup>

This does not contradict the idea of perfect rest and peace, because the element of fatigue is absent from all God's effort. The motive of creation, then, was goodness, "Everything is for the good of the creature, who is in need of receiving God's bounty" (I, 47).

The difficulty in explaining why an imperfect world was created is touched upon thus: "For the manifestation of the better, there was necessary the creation and existence of the worse; both alike are due to the power of the same goodness, viz. to God" (I, 101). Again, he says on this same general theme: "God is not a salesman lowering the price of his own possessions, but the bestower of all things, pouring forth the everflowing fountain of favors, not desiring a recompense; for neither is he in need himself, nor is any created thing competent to bestow a gift in return" (I, 161).

Philo is not so satisfactory in explaining the need of punishments. Even if one says that punishment is corrective and hence good, yet somewhat of evil is attached to it. Philo tries to avoid the difficulty by saying that God has delegated punishment to subordinates. Further, God's punishments are tempered by grace; he never puts forth all of his power but only seeks to help the one punished. So in his revelation of himself God recognizes man's limitations, as for example when Moses saw but the back of Jehovah as he passed by.

Philo is also troubled by the crass anthropomorphism of the Scriptures. In places God is called a man, in others he is not a man. The former, Philo says, is less true, but is used because man is not capable of understanding about God in any other way. "We cannot", he says, "get out of ourselves, and so we get our conceptions of the uncreated God from our own attributes" (I, 419). Philo's stand is in keeping with the best Greek thought, as when Xenophanes, for instance, says: "If cattle or lions had hands, so as to paint with their hands and produce works of art as men do, they would paint their gods and give them bodies in form like their own—horses like horses, cattle like cattle" (Frag. 6, Fairbanks).

Why should God take an oath is also explained by Philo. It is not because God needs this for himself, but it is that we may believe an oath better if God himself is supposed to employ it (I, 181, 182).

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<sup>3</sup>The tribe of Klamath Indians call God "the Old One on High" and one of their thinkers, when asked who created the world, replied "the Old One on High". When asked how he created it he said, "by thinking and willing".

The anger and jealousy of God, so often mentioned in the Old Testament, are likewise commented upon by Philo, who says that there are some people whom nothing else will appeal to. They are used for the purpose of "admonishing those who could not otherwise be brought to a sober frame of mind" (σωφρονίζεσθαι, I, 656).

Every man, even the humble and the wicked, is related to the Divine, "for he is an impress or fragment or radiance of that blessed nature" (I, 35). God is so generous that he delights to give good gifts to all his children, and he would like to encourage all to seek after righteousness. Compare with this Matthew 7, 11: "If ye then, being evil, know how to give good gifts unto your children, how much more shall your Father which is in heaven give good things to them that ask him?" And Luke 11, 13: "If ye then, being evil, know how to give good gifts unto your children; how much more shall your heavenly Father give the Holy Spirit to them that ask him?"

Even wicked persons occasionally have a sudden vision of the good, altho it quickly fades away. Also many ordinary persons have an instinctive hatred of vice (μισοπόνηρον πάθος) which makes them suddenly champion the good. This is strikingly illustrated in a modern play *Lilium* by Franz Molnar.

Altho anyone may thus have momentary glimpses of good and even of the divine nature, those who approach nearest to God are the philosophers who give themselves up to contemplation of his person and his works. This again is Plato's approximation to God. And supposing one fails to see God, his reward comes in the effort as in any good pursuit (I, 186).

To search after God with any prospect of success one must first conquer the body and all allurements of the carnal nature, and exalt the mind and soul. Philo says "The body is wicked by nature and a plotter against the soul" (I, 96). As Jeremiah says (17, 9): "The heart is deceitful above all things, and desperately wicked; who can know it?"

The same ideas are conspicuous in Epictetus, the Evangelists, and Paul. Philo has a lurking regard for asceticism as had Plato. Today we express the idea in the words "plain living and high thinking".

Tho not advocating suicide as did some of the Stoics, Philo urges one to escape from the polluted prison-house of the body (I, 437, 264), and he condemns unsparingly the luxury and vice of Alexandria. St. Paul exclaimed, you remember, "O wretched man that I am! who shall deliver me from the body of this death?" (Romans 7, 24).

With all his speculation and mysticism, Philo is also very practical for he makes service to mankind the prerequisite to service to God.

Helpfulness to one's brother must come before the realization of the mystic's dream of heaven. "Human virtue must walk upon the earth, and yet must aim at heaven" are his words (I, 552). He uses the Ten Commandments to illustrate his point, for he says the first four "words" relate to God, the last five to man, while the fifth bridges the gap between God and man thru the parents. Yet in the political sphere he follows Plato's idea of aloofness from any active participation in government.

On the question of sympathy and comfort in sorrow or suffering, Philo is less satisfactory than many pagan philosophers like Plutarch, Epictetus, and Seneca, and, of course, far behind the Psalmist and the Evangelists. In the midst both of blessings and of sorrows man's attitude should be one of submission and humility. One must not have the arrogant notion of the Greek Sophists that "Man is the measure of all things." God is the only true cause, man is but a tool in God's hands. Repentance is necessary to this submission and humility. "Never to sin is the peculiar quality of God; to repent is the quality of a wise man" (I, 569). "Even in the souls of those who repent, the scars and impressions of their old wickedness will remain" (II, 405). "God, the pitying Saviour, can easily bring back the mind from long wandering, and in evil plight thru pleasure and lust—hard taskmasters that they are—into the right way, if only it has once determined to pursue the good flight without turning round" (II, 427).

Altho God is in a sense present in everyone by virtue of the breath of creative power, yet he dwells above all in the souls of the good. "A fitting soul alone is a worthy house for God" (I, 175; II, 672). In Second Corinthians 6, 16, Paul says: "for ye are the temple of the living God."

One's good nature, assisted by proper training, and with God's help, will lead to the desired result. Persons enter into life with certain endowments which in a measure determine their destiny. But nature is not alone in this task; if it were one would be "predestined" to a certain fate, and Philo avoids this difficulty, tho in a rather unsatisfactory way. Heraclitus, ages before Philo, saw more clearly when he said, *ἡθος ἀνθρώπου δαίμων* (Fragment 121, Fairbanks) "Character is a man's guardian divinity", where *ἡθος* means the sum total of what a man makes of himself. Compare with this Philippians 2, 12: "Work out your own salvation with fear and trembling." Philo says that man is aided in working out his salvation by the Divine *λόγοι*. In explanation of this he says that help comes to one person as a sudden and inspiring thought, to another a fine



passage from a book, and to another the words of a great teacher. As Philo words it: "On some the Divine Logos enjoins commands like a king; others it instructs as a teacher his pupils; others not knowing what is best for themselves it helps as a counsellor who makes wise suggestions; while to others, again, like a gracious friend, it reveals persuasively many mysteries that the uninitiated may never hear" (I, 649). Jesus says in Matthew 11, 25: "I thank thee, O Father, Lord of heaven and earth, because thou hast hid these things from the wise and prudent, and hast revealed them unto babes." "When a soul is self-sufficient", Philo says, "the Logos holds aloof; when it confesses its weakness, the Logos comes to meet it" (I, 638).

While Philo's aim is to approach as near as possible to God, he is forced to admit that the only positive fact that we can know about God is the fact of his existence. His works show his wisdom and power and goodness. The Logos helps us to understand God's attributes, tho of course very imperfectly. Only a limited number of select spirits ever advance beyond the Logos toward God himself. Inspiration follows complete triumph over the carnal desires and absolute consecration of mind and soul to God (I, 76, 380).

Fear and Love are fundamental attributes in Philo's conception of God. Then, under the Logos, are the Creative and Ruling functions. "By goodness God created the universe, by authority he rules it, and the Logos unites the two, for by Reason (or Thought) God is both ruler and goodness" (I, 144). It is a great step in one's thinking when one realizes that the world one sees has been created and that there must have been a creator. This leads to Awe or Fear of the creator first, and then to Love. Love and Fear of God are united by the Logos, but the philosopher tries to pass beyond ideas of Love and Fear, to find and adore God for simply what he is, and not for what he has done for man. Worship helps in this.

As to forms of worship, Philo holds to ancient traditions, but points out that forms should not take the place of true religion. "If a man practices ablutions", he says, "and purifications but defiles his mind while he cleanses his body; or if, thru his wealth, he founds a temple at a large outlay and expense; or if he offers hecatombs and sacrifices oxen without number, or adorns the shrines with rich ornaments, or gives endless timber and cunningly wrought work, more precious than silver or gold, let him none the more be called religious. For he has wandered far from the path of religion, mistaking ritual for holiness, and attempting to bribe the Incorruptible, and to flatter him whom none can flatter. God welcomes genuine service and that is the service of a soul that offers the bare and simple sacrifice of truth, but from false service, the mere display of material

wealth, he turns away" (I, 195). We recall at once the first chapter of Isaiah where the Lord asks (in verse 11) "To what purpose is the multitude of your sacrifice unto me?" and in verse 13, "Bring no more vain oblations", and in verse 14, "Your new moons and your appointed feasts my soul hateth; they are a trouble unto me; I am weary to bear them", and finally Psalms 51, 17: "The sacrifices of God are a broken Spirit: a broken and contrite heart, O God, thou wilt not despise."

Again, Philo says in this connection: "Let those who seek to show honor and gratitude to God cleanse themselves of sin; washing away all that defiles life in word and thought and deed", and "The only true sacrifice is the piety of a God-loving soul" (I, 273, 274; II, 151).

A curious passage is that in which he tells of the angels' one and only criticism of creation, the need of a creature with voice to chant God's praise. In answer to this criticism God created man gifted with ability to sing. But hymns would, according to Philo, include not only those which find vocal utterance, but also the silent gratitude of the heart.

The following is also noteworthy: "Of the works of creation two things are holy—heaven, which immortal and blessed natures pervade, and the mind of man, which is a fragment of the Divine" (I, 625, 626). This suggests at once Kant's famous words:

"Zwei Dinge erfüllen das Gemüth mit immer neuer und zunehmender Bewunderung und Ehrfurcht, je öfter und anhaltender sich das Nachdenken damit beschäftigt: der bestirnte Himmel über mir, und das moralische Gesetz in mir" (Immanuel Kant, *Kritik der praktischen Vernunft*, Th. II, Beschluss, Vol. V, p. 167, ed. of G. Hartenstein: Leipzig, Voss, 1867).

After Love and Fear of God, Philo places Faith, as chiefest of the virtues. But to him Faith is not the beginning of virtue but its goal. Perfect Faith belongs to the perfect man only. Faith is not opposed to knowledge of a thing or a person, for the more knowledge one has of these the more faith he has in them. Faith in God also implies the lack of faith in creation and in oneself. Faith in God, however, implies perfect freedom. The well-known Collect, "In whose service is perfect freedom", might have been worded by Philo. "Nothing so completely liberates the mind", he says, "as to become a servant and suppliant of God" (I, 534). No commands are needed to the perfect man to do God's will, for "The perfect man is impelled by himself to virtuous deeds." Compare Jesus' words in John 4, 34; "My meat is to do the will of him that sent me, and to finish his work." Philo illustrates by the example of Abraham, at the close of his

*Life* of that man of faith, saying: "Such was the life of the founder and captain of the nation—a life, so some will say, according to law, but, as my argument has proved, itself a law and unwritten ordinance." So also the good man needs no reward. "Virtue", as we say, "is its own reward." "The good man seeks the day for the day's sake, light for light's sake, and the good for the sake of the good, and for no other thing. For this is the Divine Law, to honor virtue for itself" (I, 120).

The prizes one should aim after are not material but spiritual—faith, joy, and a vision of God (II, 412).

Hope, Philo regards, as the seed from which Faith grows. Hope is the foundation of our life (II, 410). Joy is another of the virtues to be cultivated. Of this virtue he takes Isaac as the type since his very name signifies "laughter". Laughter is the outward manifestation of the invisible joy of the soul. Joy, of course, is not pleasure.

Peace is another of the virtues. "No man can be at peace who does not truly serve the only Being that is wholly exempt from war and abides forever in eternal peace" (I, 368). As Isaiah says (26, 3): "Thou wilt keep him in perfect peace, whose mind is stayed on thee; because he trusteth in thee." Such peace no man can bestow. Rest secure in God and so enjoy peace (II, 129). With this compare the words of Jesus in John 14, 27: "Peace I leave with you, my peace I give unto you: not as the world giveth, give I unto you. Let not your heart be troubled, neither let it be afraid."

Forgiveness, according to Philo, depends upon whether you forgive others, for he says: "If you ask pardon for your sins, do you not also forgive those who have trespassed against you" (II, 670). This is in harmony with Christ's own teachings as found in the Lord's Prayer (Matthew 6, 12), and in Matthew 5, 23-24: "Therefore if thou bring thy gift to the altar, and there rememberest that thy brother hath aught against thee; Leave there thy gift before the altar, and go thy way; first be reconciled to thy brother, and then come and offer thy gift."

Philo's definition of true greatness is most interesting and original. It is "to be near to God, or near to that to which God is near".

Finally, Philo would be a good patriot if he were a Jew living today in America, say, and above all a good citizen of the world in fellowship and understanding with all men. The following passages will prove these points. First, he says to the Jews of his day: "One country cannot contain all the Jews because of their large numbers, for which reason they are spread over most parts of Asia and Europe, both on the mainland and on islands. They regard Jerusalem, in which lies the Holy Temple of the Most High God, as their mother city;

but the various countries in which their fathers, grandfathers, and ancestors have dwelt they regard as their fatherlands, for in them they were born and bred" (II, 524).

And from the broader view of citizenship, he says: "Let there be one bond of affection and one password of friendship, devotion to God, making piety the motive of every word and deed" (II, 259), and again: "For the most potent love charm and the indissoluble bond of good-will that makes for unity, is the worship of the one God", and lastly: "Relationship is not measured by birth alone, under the leadership of truth, but by similarity of interests and the pursuit of the same ends."

After this examination of Philo's religious ideas one feels that in spite of the strangeness of the doctrines here and there, and the curious blend of Hebraism and Platonism, we have in him a true philosopher and as earnest a seeker after God as any of those described in Canon Farrar's justly famous book. It is easy for a modern to sneer at the knowledge and the speculation of the ancients, but are we sure that centuries hence our ideas will not be the subjects of the jeers and scoffs of a more advanced world?

On this point Anna M. Stoddart, in her fascinating *Life of Paracelsus*, p. 105, quotes the words of Anatole France: "Le progrès des sciences rend inutile les ouvrages qui ont le plus aidé à ce progrès. Comme ces ouvrages ne servent plus, la jeunesse croit de bonne foi qu'ils n'ont jamais servi à rien."

To this she adds this comment: "Anatole France in these significant words has laid bare our intellectual ingratitude, our inability to realize the miracles of a past which engendered our miraculous present."

The same is more fully expressed by Joseph B. Mayor, in his *Sketch of Ancient Philosophy*, p. XIV: "It is possible to be provincial in regard to time, as well as in regard to space; and there is no more mischievous provincialism than that of the man who accepts blindly the fashionable belief, or no-belief, of his particular time, without caring to inquire what were the ideas of the countless generations which preceded, or what are likely to be the ideas of the generations which will follow. However firm may be our persuasion of the Divinely guided progress of our race, the fact of a general forward movement in the stream of history is not inconsistent with all sorts of eddies and retardations at particular points; and before we can be sure that such points are not to be found in our own age, we must have some knowledge of the past development of thought, and have taken the trouble to compare our own ways of thinking and acting with those that have prevailed in other epochs of humanity."



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I have used all of these and wish to acknowledge my indebtedness here.

F. W. T.











# INDIANA UNIVERSITY STUDIES



## Study No. 53

STUDIES OF SOME NEW AND DESCRIBED CYNIPIDÆ  
(Hymenoptera). By ALFRED C. KINSEY, Assistant Professor of  
Zoölogy, Indiana University.

VARIETIES OF A ROSE GALL WASP. By ALFRED C. KINSEY  
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*The INDIANA UNIVERSITY STUDIES are intended to furnish a means for publishing some of the contributions to knowledge made by instructors and advanced students of the University. The STUDIES are continuously numbered; each number is paged independently.*

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# Studies of Some New and Described Cynipidæ (Hymenoptera)<sup>1</sup>

By ALFRED C. KINSEY, *Assistant Professor of Zoölogy in  
Indiana University*

THIS paper, with the appended paper, offers descriptions of 107 American gall wasps, 70 of which have not been previously described, revises *Plagiotrichus*, a genus not heretofore recognized in the American fauna, recognizes one new genus, *Heteræcus*, and offers some data on the variation, distribution, life histories, and phylogeny of the insects. Seventy of the cynipids described are from the Pacific Coast of the United States.

Probably the most notable departure in this paper is the recognition of varieties. No varieties have been recognized previously in American Cynipidæ, and only a very limited use has been made of them in Europe. This is too true for most fields of entomology. Two practices have been followed: closely similar forms have been considered as haphazard variations of one species; or varieties have been considered as distinct species, as have 18 of the varieties treated in this paper, belonging to seven species. However, variations are usually orderly and abrupt, and much biologic data has been buried by ignoring minor differences. In many cases where the related forms were described as distinct it was due to ignorance of previously described forms, and they have been maintained as distinct by later workers thru continued ignorance of the meanings of the descriptions. Most of these descriptions are truly unusable because they make no comparisons with other forms, and usually fail to describe the very characters in regard to which there is any variation. Great confusion has been introduced by the reduction to synonymy of these related things; in the process much biologic data has been scrapped, not to be recovered without difficulty. I acknowledge having copied all of these practices in my own previous publications.

<sup>1</sup>Contribution from the Zoölogical Laboratory of Indiana University No. 186 (Entomological No. 2).

It cannot be hoped that I have now entirely untangled the confusions regarding even the species treated in this paper, but perhaps my method will ultimately prove profitable.

By the use of trinomials the specific unity of a group is recognized, and means are provided for the introduction of comparisons to discover the character of the variations and possibly some of the factors; to distinguish differences in physiologic characters such as host preference, gall form, date of emergence, and occurrence of heterogeny, in regard to all of which closely related varieties may vary; and to give a basis for the understanding of questions of distribution. The only possible objection to the recognition of varieties will be the less convenient nomenclature necessary, but this is not a great consideration in view of the advantages of the practice.

In recognizing the limits of varieties these are the general rules I follow: (1) The morphology of the adult insect, rather than the gall characters or other such data, is the prime consideration. (2) Any character, no matter how trivial or intangible, is of importance if it is constant in any large proportion of individuals. (3) No variety is based on trivial morphologic characters alone; physiologic characters as expressed in the structure of the gall, in the choice of host, geographic distribution, or other general biologic characteristics always contribute evidence for a similar interpretation. (4) Conversely, no single sort of biologic data, nor set of such data, is the basis for recognizing a variety unless it is paralleled by morphologic evidence. (5) No variety has been designated unless at least one of the varieties of the species is represented by material from more than one locality. If there is any exception to the above rules, it is because the data of certain sorts are overwhelmingly good for the attitude taken. Statistical methods applied to lesser differences may disclose the existence of still further order in variation. I have not employed this method simply because other, more important problems with Cynipidæ demand our present attention, and are likely to do so for some time.

The question of host relationships of cynipids is considerably cleared up by this treatment of varieties. It appears that some species show no constant variation (unless possibly discernible by statistical methods) when occurring upon different oaks in the same region, while other species have de-

veloped distinct varieties on each host. In this case the amount of host variation is usually less than that of geographic varieties, but sometimes it is more. In every case the varieties of a single species are confined to either white or to black oaks, altho closely related species may occur on oaks of both groups.

Many undescribed varieties have been previously overlooked because of a charming lack of knowledge of faunal areas and possible factors of distribution. It would be the rankest sort of farce to delimit faunal areas on the basis of the published records of distribution of Cynipidæ, based on determinations which neglect varietal differences! We have yet to learn that some of the distribution work has no better foundation than such careless taxonomy. It now appears that each variety is restricted to a limited, more or less continuous geographic area; in no case does a single variety extend over more than one faunal zone, and in only two or three of the Cynipidæ I have studied does more than a single variety of one species occur in a single faunal area. These areas I have of necessity in part defined by studying Cynipidæ themselves, when the several species of a region prove to agree most remarkably in the extent of their range. A consideration of the ranges of other organisms has been of some help in these interpretations, but there is not much trustworthy literature available. For the Pacific Coast good work on oaks has been done by Jepson (1910, Mem. Univ. Calif., II, pp. 202-241), and there is a remarkable study of the distribution of beetles by Van Dyke (1919, Ann. Ent. Soc. Amer., XII, pp. 1-12). My studies of Cynipidæ very largely bear out Van Dyke's conclusions as far as we have covered the same fields. Undoubtedly many factors have contributed in limiting the distribution of cynipid species. Host distributions do not appear to have had much if any positive influence, altho acting negatively to some extent, as when oaks are entirely absent from a region. I must admit some prejudice for believing that the past geologic history of an area is the most potent factor in present distributions. The newer country, geologically, appears to possess the newer varieties. All of these questions I shall consider in detail after a further study of Cynipidæ.

The genera of Cynipidæ have always needed revision, and the introduction of two terms new to American literature is



part of my program of revision of gall wasp genera. All of the generic terms used in this paper define distinct, phylogenetic groups with the exception of the term *Andricus*. A good genus *Andricus* can be separated some day, building about the type species, but until then the term covers a waste basket. I do not mean to imply the close relationships of the species here placed in *Andricus*, but rather to indicate that their generic positions cannot yet be defined. I employ *Cynips* to indicate a good genus, of which *Cynips folii* Linnæus is the type (designated by Westwood, 1840, Synop. Gen. Brit. Ins., p. 56, and reaffirmed by Rohwer and Fagan, 1917, Proc. U.S. Nat. Mus., LIII, p. 364). The majority of the species placed by both European and American authors in *Cynips* do not belong to that genus, and some of those placed in *Dryophanta* Förster (isogenotypic with true *Cynips*) and *Diplolepis* Dalla Torre and Kieffer (not *Diplolepis* Geoffroy!) belong to true *Cynips*. *Cynips* is here used in a restricted sense which I shall more fully explain later. I am not using the name *Callirhytis* because its type is unrecognizable. In the original establishment of the genus Förster included his *Callirhytis hartigi* and designated it as type. *Hartigi* was poorly described, without a host record, and without a locality record, altho probably the insect came from Germany. As far as I know, the insect has never again been recognized. Later authors have more or less generally adopted characters to restrict the term, particularly that of a simple tarsal claw. However, it is not known whether *hartigi* had simple or toothed claws, and until we again recognize that species the later restrictions on the term *Callirhytis* cannot have any standing. Certain it is that the group as generally defined today in no sense defines a phylogenetic unit, and is meaningless. I prefer to reduce these meaningless terms, and shall use only *Andricus* in that way.

Some years ago I heard Dr. W. M. Wheeler remark that what we needed in taxonomy was not longer, more detailed descriptions, but pointed comparisons of related forms. These comparisons are possible only when much material is available. As far as possible I have used the method, and I think with highly satisfactory results.

I have no interest in taxonomy *per se*, for it is not a science concerned with questions of cause and effect. But until the foundation of cynipid taxonomy is developed we shall not be

able to build the structure of cynipid biology. The students of cynipid taxonomy must be the ultimate critics of the biologic hypotheses we build, and for that reason I have included a considerable body of biologic data with the taxonomic record of each insect. These data are brought together in the index. After the taxonomists have criticized, I shall draw these data together into a more general form.

The material on which these studies are based was mostly collected during 1919 and 1920 while I held a Sheldon Traveling Fellowship of Harvard University. Fully half of the new Cynipidæ I obtained at that time are not yet described, and the volume of biologic data is not yet touched. This is the second paper I have based largely on this material, the first having been published recently (1922, *Bull. Amer. Mus. Nat. Hist.*, XLVI, pp. 279-295), and others should follow soon. Great credit is due the Harvard University authorities, especially Dr. William Morton Wheeler, who made the trip possible.

Eleven of the new varieties are described from material which was collected and bred by Dr. J. T. Patterson, of the Zoölogy Department of the University of Texas. Dr. Patterson is undertaking probably the most extensive work which has yet been done on cynipid life histories and genetics. I greatly appreciate the opportunity to describe his material, most of which I have not yet been able to study. Mr. C. W. Johnson, of the Boston Society of Natural History, Mr. William Beutenmuller, and Dr. A. L. Melander collected types, each of one of the new varieties.

A great number of friends have contributed largely to my work. Mrs. Kinsey has generously contributed encouragement, time, and skillful criticism. I have secured gifts or loans of material, particularly types, and other favors from the Museum of Comparative Zoölogy, the American Museum of Natural History, Mr. S. A. Rohwer and Mr. L. H. Weld at the U.S. National Museum, Dr. Isabel McCracken at Stanford University, Pomona College, Professor A. Trotter of Portici, Italy, and a host of friends who are not biologists. Mr. Frank A. Leach, of Diablo, Calif., is sending me material. Dr. F. E. Lutz and Mr. Andrew J. Mutchler, of the American Museum, have especially aided the work. The authorities of Indiana University, particularly the members

of the Zoölogy Department, have been liberal in their encouragement and material help. Mr. S. B. Parish, then of San Bernardino, Calif., introduced me to the Pacific Coast oaks. Dr. Forrest Shreve helped very considerably in my travel in Arizona. Mr. W. H. Vance and Mrs. I. T. Wilson have capably worked in mounting my material for study. For all of this help I am greatly indebted. Most of this work would have been impossible without such coöperation. I have not had access to the paratypes in the private collections of two of the cynipid workers, and I feel that if any injustices have been done their species some of the blame is due them.

The holotypes of all these new Cynipidæ, with one exception, are in The American Museum of Natural History. Paratypes have been distributed as widely as possible among the museums, and I shall be glad to lend or give paratypes or other material, as long as it is sufficient, to students of these insects. Any material of these species labelled cotypes should be considered paratypes.

### **Andricus californicus (Bassett)**

FEMALE.—Brownish rufous, head and thorax hairy; median groove about lacking; areolet large; first abscissa of the radius sharply angulate; length 3.0-5.0 mm. HEAD: Distinctly narrower than the thorax, broadened behind the eyes; light to dark brownish rufous, tips of the mandibles piceous to black; finely rugose, smoother about the eyes, most rugose between the eyes and the mouth, not densely hairy, almost naked on the front. Antennæ pubescent, with 14 or 15 segments, the second almost globose, the third one-third longer than the fourth, the last almost twice the length of the preceding. THORAX: Light to dark brownish rufous; mesonotum punctate and coriaceous, not densely hairy; parapsidal grooves distinct, complete or incomplete; median groove very short or lacking; anterior parallel lines fine, distinct; lateral lines moderately broad, smooth, naked; scutellum somewhat longer than wide, well rounded posteriorly, rugose, hairy, the anterior depression rugose, smoother laterally, forming more or less distinct foveæ; pronotum laterally rugoso-punctate, hairy; mesopleuræ rugose dorsally, mostly smooth and finely rugoso-punctate, scatteringly hairy. ABDOMEN: Smooth; finely and microscopically punctate posteriorly, naked except for patches of hairs latero-basally, hairs on the edges of the posterior segments, and on the ventral spine and valves; longer than broad, somewhat produced dorsally; second segment covering not more than half the area, edges of segments oblique, well rounded ventrally; ventral spine rather long, slender. LEGS: Including the coxæ, uniform in color with the rest of the body; tarsi darker; rather densely hairy; tarsal claws strong, toothed. WINGS: Slightly tinged yellow, most so in the radial and



cubital cells; anterior margins rather short-ciliate; veins brown; areolet moderately large; cubitus not reaching the basalis; radial cell moderately short, open; the second abscissa of the radius somewhat curved, the tip parallel with the margin for a short distance; first abscissa sharply angulate at almost  $90^{\circ}$ , with hardly any projection. LENGTH: 3.0-5.0 mm.

GALL.—Large, globose to reniform, smooth, twig gall. Monothalamous, or polythalamous, containing from one to a dozen larval cells. Irregularly rounded, ovate, ellipsoid to reniform, all sizes, up to 65. mm. in diameter by 113. mm. long; the surface smooth, sparingly, shallowly roughened; reddish to yellow and brown. Internally more or less filled with compacted, soft, crystalline, brown, yellow, or white material, woody from the point of attachment to above the center of the gall; the larval cells oval, averaging 4.-5. mm. long by 3. mm. wide, more or less radiantly in the woody tissue, toward the center of the gall. Laterally, on twigs of several white oaks.

RANGE.—From the Mexican border of California to Washington.

The most apparent differences between the varieties of this species are those of color and size. That we may have underestimated the constancy of these characters with some species is indicated by the absolute correlation of these differences with the physiologic differences and geographic distribution.

An astounding structural characteristic of one of the varieties is the complete parapsidal groove; the other varieties have the groove terminating very distinctly midlength of the thorax.

The occurrence of variety *californicus* upon two hosts without consequent variation, and the possible occurrence of *fructiformis* upon two more distinct hosts (as discussed under that variety), offer data concerning the non-influence of hosts upon the insect, and further confirm the idea that the gall is specific for the insect producer, without evidence of direct host influence.

The most important problem which this species may illuminate is that of the nature of alternation of generations. As discussed for each of the varieties, the northern forms quite certainly have alternate generations, but in the southern form the close concurrence of emergence dates and the appearance of fresh galls make it seem possible that there is no alternation of generations in the perpetually warm climate of southern California. If this is demonstrated it will confirm my opinion previously expressed (1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 372) that alternation of generations



is an extreme development of seasonal dimorphism. With such large adults, and monstrous and abundant galls as this species has, it should not be a difficult matter for some one on the field to experimentally discover this life history.

### **Andricus californicus variety californicus (Bassett)**

*Cynips Q. Californica* Bassett, 1881, Can. Ent., XIII, p. 51. Riley, 1881, Amer. Nat., XV, pp. 402, 403.

*Andricus californicus* Mayr, 1881, Gen. gallenbew. Cynip., p. 28. Ashmead, 1885, Trans. Amer. Ent. Soc., XII, pp. 295, 304. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm., p. 110. Dalla Torre, 1893, Cat. Hymen. Cynip., II, p. 81. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 62. Kellogg, 1914, Amer. Ins., p. 472, fig. 665. Thompson, 1915, Amer. Ins. Galls, p. 8. Felt, 1918, N.Y. Mus. Bull., 200, p. 62.

*Andricus (Callirhytis) californicus* Ashmead, 1885, Trans. Amer. Ent. Soc., XII, p. 294. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm., p. 105.

*Callirhytis californica* Ashmead, 1887, Trans. Amer. Ent. Soc., XIV, p. 132.

*Callirhytis californicus* Beutenmuller, 1904, Bull. Amer. Mus. Nat. Hist., XX, p. 25.

*Andricus quercus-californicus* Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 531, 803. Trotter, 1910, Boll. Lab. Portici, V, p. 111. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 346; 1912, Journ. N.Y. Ent. Soc., XX, pp. 275, 280.

**FEMALE.**—Shows the following characters in addition to those common to all varieties of the species: Color almost entirely light brownish rufous; antennæ slightly darker than the head, darkest mid-length, rather short, distinctly enlarged terminally, with only 14 segments; parapsidal grooves moderately broad at the scutellum, becoming finer anteriorly, not extending much more than half the length of the mesothorax; median groove lacking; scutellum with the anterior depression rugose, smoother laterally, but hardly forming distinct foveæ; length 4.0-5.0 mm.

**GALL.**—Differs from the galls of other varieties of the species as follows: Color light brownish tinged slightly reddish, to light straw yellow, usually yellow, weathering dark brown to black; usually more completely filled with the crystalline material than in other varieties. Very young galls cause a lateral swelling of the stem which often becomes 4. mm. or more high before the bark breaks; young galls are very succulent, red when first breaking thru; old galls persist on the trees for years. Maximum length observed, 113. mm. On *Quercus lobata* and *Q. Douglasii*.

**RANGE.**—Between the ranges of the other varieties. California: Grant (Trotter); Exeter, Three Rivers, Merced Falls, El Portal, Paso Robles, Byron, Oakdale, Gilroy (Redwood School), Palo Alto, Redwood

City, San Francisco; Mt. Diablo (F. B. Leach coll.); Santa Rosa, Napa, Galt, Oroville, Redding. Possibly a distinct variety occurs from San Francisco north.

TYPES.—Adults and galls at the Philadelphia Academy, The American Museum of Natural History, the Museum of Comparative Zoölogy, and in the Beutenmuller collection (?). Redwood City, California; 1878 and 1880; "*Q. Hindsii*?" (= *Q. lobata*); Wm. Sutton collector.

The adult of this variety is morphologically very similar to *spongiolus*, except in color, but it has a very distinct range and (consequently?) distinct hosts. The young galls were just beginning development at Palo Alto on March 13, and further north at Galt on March 29; adults emerge in October. Very probably an alternate generation occurs with a life history of at least five months.

The two oaks on which this variety occurs are distinct but not unrelated species, are confined to the same geographic area, and have about the same distribution, tho one occurs in somewhat different soil and averages a different elevation above sea-level. Under such circumstances it appears possible for a cynipid to inhabit both oaks without consequent variation, for as far as the material I have seen would show there are not apparent differences between insects and galls from *Quercus lobata* and *Q. Douglasii*.

### ***Andricus californicus* variety *spongiolus* (Gillette)**

*Andricus spongiola* Gillette, 1894, Can. Ent., XXVI, p. 235. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 65; 1910, Das Tierreich, XXIV, pp. 529, 803, 830. Thompson, 1915, Cat. Amer. Ins. Galls, pp. 8, 34. Felt, 1918, N.Y. Mus. Bull., 200, p. 62.

*Andricus quercus-californicus* Swezey, 1916, Proc. Haw. Ent. Soc., III, p. 222.

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color almost entirely dark rufous brown, blackish in the foveal depression and on the metathorax: antennæ very dark brown or blackish, "15-jointed" (according to Gillette); parapsidal grooves rather fine, even at the scutellum, not extending much more than half the length of the mesonotum, median groove very short or lacking; scutellum with the anterior depression forming more or less smooth, indistinctly bounded foveæ; length "5 mm." (according to Gillette).

GALL.—Differs from the galls of other varieties of the species as follows: Color light straw yellow to a unique, salmon yellow, weathering dark brown to black; occasionally bearing a few, short, blunt, tuberculate projections; internally usually softer than in the other varieties.

more often not completely filled, the tissue whiter; galls more often smaller and in compact clusters, thus becoming greatly compressed and flattened basally; maximum length observed 92. mm. On *Quercus garryana*.

RANGE.—North of the other varieties. California: Yreka. Oregon: Ashland, Grants Pass, Roseburg, Junction City, Canby; Eugene (Swezey). Washington: Olympia (Gillette); White Salmon.

TYPES. C. P. Gillette collection (?).

The adult is distinguishable from the adult of variety *californicus* primarily in color, but this difference is not as insignificant as it might seem for it is constant and is correlated with a physiologic difference shown in the gall, and a very distinct geographic range and (consequently?) distinct host. Swezey reported live adults cut from galls in July; Gillette had adults emerge thru November; I failed to find young galls yet developing on April 15. Very probably an alternate generation occurs with a life period of at least six months.

### ***Andricus californicus* variety *fructiformis*, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color almost entirely brownish rufous, only slightly darker than in variety *californicus*, sometimes blackish on the anterior parallel and lateral lines and in the foveæ; whole antennæ almost black, distinctly longer than in the other varieties, not particularly enlarged terminally, with 15 distinct segments; parapsidal grooves moderately narrow at the scutellum, finer anteriorly, but distinct to the pronotum (!); scutellum with quite distinct foveæ, wholly smooth laterally, separated anteriorly by a fine ridge; length 3.0-3.7 mm.

GALL.—Differs from the galls of other varieties of the species as follows: Color always red or reddish brown, very brilliant apple red when fresh; internally with large cavities, the little tissue which it contains, other than the woody core, being brittle, dark, resinous, appearing fused; galls usually small and monothalamous, tho the maximum length observed is 90. mm. On *Quercus dumosa*.

RANGE.—South of the other varieties. California: Descanso, Alpine, Fallbrook, Sorrento, El Toro, Upland, Pasadena, Paso Robles.

TYPES.—12 females, 30 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at the U.S. National Museum, Stanford University, and with the author. Galls at the Museum of Comparative Zoology, and the Philadelphia Academy. Labelled El Toro, California; February 14, 1920; *Q. dumosa*; Kinsey collector.

Morphologically the insects of this variety are remarkably similar to those of other varieties except in color and



size, and in having a complete parapsidal groove. Inasmuch as the difference between a distinctly incomplete and a distinctly complete parapsidal groove has been considered of generic significance among several groups of Cynipidæ, it is very significant to find both conditions among varieties of a single species, and possibly within this single variety. Insects from Pasadena material agree with El Toro material. Variety *intermedius* comes very close to this variety.

The Descanso record, based on galls alone, may need further investigation, for there is indication from other sources that a distinct faunal area occurs in the very southern part of California. Galls taken on *Quercus lobata*, at the Encino Ranch near Zelzah, appear to be of this variety rather than of *californicus*, which is the variety normally on *lobata*. I do not have insects from these galls, so I cannot be sure of their relations. If further collecting proves they are *fructiformis* we shall have an extremely important case of the same species occurring on quite different oaks without material effect by the host upon the insect. This is an extreme southern station for *Quercus lobata*, and is quite distant from other stations. A very low pass between the Sierra Madre and the Santa Monica Hills connects this part of the San Fernando Valley with southern California.

A few insects had not emerged at Upland on February 3; in the same latitude, a few adults emerged from the Pasadena galls after February 7, tho most of them had emerged previously. Forty miles south of Pasadena, at El Toro, on February 14, many of the galls contained live adults, with some of the insects previously emerged. At the same time young galls were found in several stages of development. At Fallbrook, by February 26 all the adults had emerged, and fresh galls grown almost to full size were abundant. The emergence period then seems to be early February, earlier in the north; the fresh galls soon appear, rapidly attaining a considerable size. It is possible that an alternate generation takes just about one or two years for its life; but it is also possible that the fresh galls of late February are the products of eggs laid by the adults emerging in early February, without an alternate generation's intervening. If the Zelzah material proves of this variety, there will arise the further question of a difference in life history there. Tho the old galls



were very abundant at this place on March 3, no new galls were in evidence.

Undoubtedly this distinct variety, previously undescribed, has been repeatedly observed by numerous entomologists, including collectors of Cynipidæ, but it and its inviting problems of such general biologic import have probably been dismissed with the remark, quoting from the literature: "The familiar 'oak-apple'".

### **Andricus californicus variety intermedius, new variety**

**FEMALE.**—Shows the following characters in addition to those common to all varieties of the species: Color rich rufous brown, mostly dark, darker than in any other variety, blackish on the lateral lines, in the foveæ, on the edges of the mesopleuræ, on the abdomen dorso-basally, and elsewhere; antennæ dark brown, only somewhat enlarged terminally, not very short, with only 14 segments; parapsidal grooves fine at the scutellum, finer anteriorly, extending only two-thirds to the pronotum; median groove lacking; scutellum with the anterior depression partly smooth and shining, forming quite distinct foveæ; areolet of moderate size, distinctly smaller than in *fructiformis*; length 3.7 mm.

**GALL.**—Practically identical with the galls of variety *fructiformis*. On *Quercus dumosa*.

**RANGE.**—California: San Bernardino Mountains. Probably confined to this mountain range.

**TYPES.**—1 female, 7 galls. Holotype female, paratype gall at The American Museum of Natural History; paratype galls at Stanford University, the U.S. National Museum, and with the author. Labelled San Bernardino, California; January 31, 1920; Kinsey collector.

Most of the adults had emerged by January 31, but one live female was still in the gall. The galls were abundantly eaten into, probably by birds.

This variety shows evident relationship to variety *fructiformis*, but is astounding in its distinctness. The galls of the two are remarkably similar. Tho *fructiformis* has complete parapsidal grooves, this closely related variety has distinctly incomplete grooves, further emphasizing the lack of generic value to this character. There is no indication in this variety of a division in the fourteenth segment of the antenna, and *fructiformis* regularly shows fifteen distinct segments.

*Intermedius* may be largely confined to the San Bernardino, as are most other varieties of cynipids found in that range, as far as we know. Of all instances of this remarkable distribution, *intermedius* furnishes one of the most distinct.

**Andricus dimorphus** variety **verifactor**, new variety

*Cynips vacciniiformis* [gall only!] Beutenmuller, 1913, Trans. Amer. Ent. Soc., XXXIX, p. 247. Felt, 1918, N.Y. Mus. Bull., 200, p. 80.

FEMALE.—Hairy; parapsidal grooves not continuous, smooth at bottom; foveæ distinct; areolet large; most of the wing veins faint. HEAD: Not as wide as the thorax, somewhat enlarged behind the eyes; rufo-piceous, almost black toward the mouth; finely roughened, shallowly and finely rugose on the face; distinctly hairy except on the vertex; without malar groove. Antennæ brownish, darker in places, especially terminally; distinctly but not greatly thickened terminally; with 14 segments, the second slightly elongate, the third half again as long as the fourth, the last not quite twice the length of the preceding. THORAX: Wholly black; mesonotum finely coriaceous and rather closely punctate and hairy; parapsidal grooves moderately broad posteriorly, rather shallow, smooth at bottom, arcuately convergent posteriorly, finer anteriorly, extending only half way to the pronotum; median groove lacking; anterior parallel lines not prominent, slightly divergent posteriorly; lateral lines rather broad, not quite smooth; scutellum longer than wide, moderately rounded posteriorly, finely coriaceous rugose, punctate, and hairy, a slight median ridge indicated posteriorly; foveæ distinct but shallow, quite rounded, smooth at bottom, rather broadly separated; pronotum rugoso-striate laterally; mesopleuræ hairy and punctate about the edges, centrally more smooth and naked, limitedly aciculate in the very center. ABDOMEN: Piceous to black, browner posteriorly, the second segment smooth, with patches of hairs latero-basally, the other segments microscopically punctate and mostly naked; distinctly longer than high, not produced dorsally, the second segment covering two-thirds of the area, its posterior edge almost vertical, rounded ventrally; ventral spine long and slender, ventral valves at about 60°. LEGS: Piceous black, yellow brown at the joints and on the tibiæ and tarsi of the front and middle legs; hairy; tarsal claws of moderate weight, simple. WINGS: Clear; only the hind margins ciliate: long and rather narrow; subcosta and cross-veins light brown, the others fine and faint; areolet of moderate size or larger; cubitus not continuous; radial cell open, moderately long and wide, the second abscissa of the radius rather distinctly curved, the first abscissa distinctly angulate, without a projection. LENGTH: 2.2-3.2 mm., averaging nearer 3.0 mm.

GALL.—Clustered, seed-like leaf galls. Each gall monothalamous, elongate, rather cylindrical, urn-shape, broadest at the middle, less broad apically, flattened at the end, taper-pointed basally, up to 4.0 mm. in diameter by 6.0 mm. in length; colored dark green when young, becoming a dark red or purplish red when old. Mostly solid and fleshy when young, becoming hard, thin-walled, and hollow when old, without a distinct larval cell lining. In compact clusters of up to 30 galls, attached to the midrib, on the under sides of leaves of *Quercus stellata* (and *Q. breviloba*?).

RANGE.—Texas: Buffalo, Hearne, Elgin, (Leander?), Austin.

Probably thruout more eastern Texas and a part of Oklahoma and Louisiana.

TYPES.—36 females, 3 pins of galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls with the author; paratype females at the U.S. National Museum, Stanford University, the Philadelphia Academy, and the Museum of Comparative Zoology. Labelled Austin, Texas; February 12 to March 8, 1922; *Q. stellata*; Patterson collection number 6.

This gall is very common on the post oaks in Texas. Patterson states that the punctures from which the galls will arise may be detected about the first of May, that the galls do not develop from the scars until about the middle of July, that the galls are fully grown in size by the first of October, and in a couple of weeks most of them fall to the ground. I have collected them in late November and December, but the larvæ are then still so small that they do not mature after becoming dry. Evidently they need to be kept moist, as they are when lying on the ground, to allow the insect to develop. Patterson secured over a hundred adults which emerged from February 12, 1922, to March 8. Inasmuch as the breeding of the insect is difficult unless carefully handled on the field, we are considerably indebted to Dr. Patterson for successfully rearing the adult.

I collected the galls, but did not obtain the insects from the other Texas localities listed. It is possible but not probable that other varieties occur at some of those points. The gall occurs on *Q. breviloba* at Leander, and Patterson reports it as occasionally on *breviloba* at Austin. It is not unlikely that the *breviloba* insect is a distinct variety with a range centering about Burnett County, Texas.

This is certainly a variety of *Andricus dimorphus*, described as a *Cynips* (Beutenmuller, 1913, Trans. Amer. Ent. Soc., XXXIX, p. 245) from galls taken by Weld at Evanston, Illinois, on *Q. macrocarpa*. Similar galls have been recorded and are common on white oaks of many species from the whole of eastern United States. Unfortunately I cannot examine the types of *dimorphus*, and cannot furnish a comparative description. Probably several different varieties occur in several faunal areas, and possibly different varieties on different hosts. This variety appears to differ from *dimorphus* in having the thorax less roughly rugose, the parapsidal grooves and lateral lines smooth, and the first abscissa of the



radius not infuscated. Probably an examination of the *dimorphus* type would modify this comparison and disclose other points of difference.

*Cynips vacciniiformis* was described from *Q. stellata* galls which are undoubtedly those of *verifactor*, and from Austin. But the description of the single insect obtained is far from correct for the true producer of this gall, and apparently applies to a different species mistakenly supposed to have come from *verifactor* galls. *Vacciniiformis* was described in 1913. Of course insects bred from galls collected in 1917 and now labelled cotypes in at least a couple of collections, cannot have any standing as type material.

### **Andricus lasius (Ashmead)**

FEMALE.—Mostly rufous, head and thorax moderately hairy, antennæ with 14 or 15 segments; median groove almost lacking; cubitus very faint, short; length under 2.5 mm. HEAD: Not quite as wide as the thorax, distinctly enlarged behind the eyes; lighter or darker rufous, darker on tips of mandibles; finely rugose, scatteringly hairy, front almost naked. Antennæ brown, lighter basally; hairy; with 14 or 15 segments, the first not especially long, the second globose, the third not much longer than the fourth, the last more than twice the length of the preceding or incompletely divided. THORAX: Entirely yellow rufous; moderately hairy; mesonotum punctate, parapsidal grooves distinct, gradually convergent posteriorly, only gradually divergent anteriorly; median groove almost lacking, brokenly indicated at the scutellum; anterior parallel lines barely indicated, lateral lines distinct, long, smooth, and naked; scutellum elongate, broadest almost at the posterior end, shallowly punctate to rugoso-punctate; the basal foveæ narrow, smooth at bottom, divergent, widely separated; pronotum laterally finely rugoso-punctate; mesopleuræ smooth, punctate, finely rugose beneath the tegulæ, less densely hairy. ABDOMEN: Lighter or darker rufous, darkest dorsally, smooth, hairy latero-basally, on the ventral spine, and on the ventral valves; edges of segments almost vertical, the ventral edges only slightly rounded, ventral spine short, blunt. LEGS: Yellow rufous, middle and posterior tibiæ and all tarsi darker; quite hairy; tarsal claws moderately heavy, toothed. WINGS: Clear, hairy, the margins ciliate; cross veins and subcosta brown; areolet of moderate size; cubitus very faint, not extending half way to the basalis; radial cell open, rather long, second abscissa of the radius distinctly curved; first abscissa arcuate-angulate. LENGTH: 2.0-2.5 mm.

GALL.—A more or less globular, wool-covered, leaf gall. Polythalamous, with a half dozen or fewer cells. Roughly globular, flattened basally, 10. mm. in diameter, covered with short, dense wool about 2. mm. thick, the wool at first bright golden brown, weathering light gray or black. Internally hard, woody, solid except for the larval cells, which



average 2.5 x 1.5 mm., and which are arranged rather radiantly about the mid-point of the base. Attached by a slight projection of the woody gall to the mid-vein or often to the petiole, occasionally two together, on either surface, usually on the under surfaces of leaves of *Quercus chrysolepis*.

RANGE.—California: El Toro to Ukiah and Dunsmuir.

I cannot fix characters which will distinguish the galls of the varieties, for they are very similar. Here is an instance of the physiologic measure of the insect varying less than does the morphologic. Morphologically the varieties are also very similar. What differences do exist are correlated with the occurrence of the faunal areas.

### ***Andricus lasius* variety *lasius* (Ashmead)**

*Callirhytis lasius* Ashmead, 1896, Proc. U.S. Nat. Mus., XIX, p. 132. Thompson, 1915, Amer. Ins. Galls, pp. 20, 29. Felt, 1918, N.Y. Mus. Bull., 200, p. 115.

*Callirhytis lasia* Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 66; Das Tierreich, XXIV, pp. 567, 815, 829. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 356.

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Almost entirely yellow rufous, antennæ light brown, rufous basally; parapsidal grooves rather less closely convergent at the scutellum; abdomen yellow to brownish rufous, darkest dorsally, about as wide as long, the second segment covering more than half the area; middle and posterior tibiæ and all tarsi brownish; wing veins light brown, first abscissa of the radius bent very close to the subcosta; areolet moderately large.

GALL.—Does not differ particularly from galls of the other varieties.

RANGE.—California: Dunsmuir(?), Auburn, Placerville. Probably occurs in the central Sierras, north of El Portal, wherever *Q. chrysolepis* occurs.

TYPES.—Females and galls; in the U.S. National Museum; labelled No. 3091. Placer County, California; December 19, 1885; Albert Koebele collector.

The above descriptions are made from types of this variety and from my material. Ashmead bred adults December 19, and January 2; in the Museum of Comparative Zoölogy is material bred December 15, by Dr. I. McCracken. All but a very few of the adults had emerged before my collecting in March and April; these very few other adults died without emerging. The most northern record, Dunsmuir, is for galls only; adults from that locality may prove to be of still another variety.

***Andricus lasius* variety *sublasius* new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Almost entirely rufous brown, antennæ dark brown, almost black, brownish rufous basally; parapsidal grooves rather more closely convergent at the scutellum than in either other variety; abdomen dark rufous brown, darker dorsally, more elongate, longer than high, second segment not covering half the abdomen; tibiæ very dark brown; wing veins darker brown, the first abscissa of the radius bent nearly midway between the subcosta and areolet; areolet moderately large.

GALL.—Does not differ particularly from galls of the other varieties.

RANGE.—California: San Bernardino. Probably confined to this range of mountains.

TYPES.—7 females, 11 galls. Holotype female, paratype female, and galls in The American Museum of Natural History; paratype females and galls in Stanford University, the U.S. National Museum, and with the author. Labelled San Bernardino, California; January 31, 1920; Kinsey collector. All the adults were cut from the galls.

***Andricus lasius* variety *areolaris*, new variety**

*Acraspis* n. sp. Trotter, 1910, Boll. Lab. Portici, V, p. 106, pl. 1, figs. 16, 19, 20.

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Almost entirely rufous brown; antennæ dark brown, almost black; parapsidal grooves not as closely convergent at the scutellum as in *sublasius*; abdomen dark rufous-brown, longer than high, the second segment covering about half the area; tarsi brownish rufous; wing veins about as heavy as those of *sublasius*; the first abscissa of the radius bent about midway between the subcosta and areolet; areolet somewhat smaller than in other varieties.

GALL.—Does not differ particularly from galls of the other varieties.

RANGE.—California: Yosemite, Pasadena (Trotter); El Portal, San Jacinto Mountain, El Toro. Probably occurs thruout the southern Sierras and their extensions, from El Portal south, except in the San Bernardino and Cuyamaca mountains.

TYPES.—1 female, 10 galls. Holotype female, paratype galls in The American Museum of Natural History; paratype galls at Stanford University, the U.S. National Museum, and with the author. Labelled El Portal, California; March 26, 1920; Kinsey collector.

This insect shows a curious combination of the characters of the other two varieties. The records for all localities except El Portal are for galls alone, and their determinations are based on our knowledge of faunal areas indicated by other species.

**Andricus operator** (Osten Sacken)

**FEMALE.**—Generally rufous; antennæ with 12 segments; median groove almost lacking; many of the wing veins very faint; areolet about closed. **HEAD:** Fully as wide as the thorax, distinctly enlarged behind the eyes; rufous, the tips of the mandibles piceous; finely granulose, almost naked of hairs except about the mouth. Antennæ yellowish, slender in the bisexual female, stouter in the agamic female, of moderate length, slightly thicker terminally, with 12 (13) segments, the second shortest but quite elongate, the third only slightly longer than the fourth, the last more than twice the length of the preceding or obscurely divided. **THORAX:** Of a uniform rufous; mesonotum very finely rugulose rugose, almost naked but with a few, very short hairs; parapsidal grooves widest posteriorly, continuous, rather abruptly divergent anteriorly; median groove almost absent or just discernible at the scutellum; anterior parallel lines barely indicated in the bisexual female; lateral lines fine, smooth; scutellum small, rather longer than wide in the bisexual female, wider than long in the agamic female, rugose, with the two foveæ distinctly separated by a fine ridge; pronotum laterally very finely rugose; mesopleuræ wholly, very finely rugose, aciculated centrally, naked. **ABDOMEN:** Wholly rufous brown, darkest more posteriorly especially dorsally; smooth, naked, edges of segments finely, faintly punctate; quite a little longer than wide, hardly produced dorsally, and the edges of the segments not far from vertical in the bisexual female; somewhat produced dorsally, the edges of the segments strongly oblique in the agamic female; segment two covering two-thirds of the area; ventral spine fine, rather short; ventral valves toward the vertical. **LEGS:** Rufous, including the coxæ; tarsal claws rather fine, simple. **WINGS:** Clear; edges not ciliate; subcosta and cross veins a medium brown, the other veins very fine and faint, the terminal part of the subcosta very faint or lacking; areolet closed; cubitus very short and faint; radial cell of moderate length, slender, open, the second abscissa of the radius almost straight; the first abscissa weakly angulate. **LENGTH:** Of the bisexual female, 1.7-2.7 mm.; of the agamic female, 3.2-3.5 mm.

**MALE.**—Differs from the female of the species as follows: Face yellowish; antennæ yellowish, decidedly thicker than in the female, with 14 segments, the third clavate, incised basally, the last not as long as the preceding; abdomen elongate, slender, the second segment covering three-quarters or more of the area; legs yellowish; length averaging less than in the female.

**GALL.**—An oval larval cell, mostly inseparable from and occupying most of a thin-walled, seed-like capsule. These capsules woolly, clustered in the bisexual generation, naked in the agamic generation, producing the following forms of galls; on eastern American black oaks.

**Bisexual Generation:** Large, compact masses of wool, irregular in shape, often oval, up to 40. by 55. mm. in dimensions; the hairs at first crisp, succulent; greenish, white, or rose-tinged, sometimes deep red; becoming straw color or golden brown upon aging, finally weathering bluish gray or black, shrivelling considerably. Within the wool,



scattered or in small clusters, mostly toward the center of the gall, are the seed-like capsules with the closely imbedded larval cells, each capsule hard, oval, about 1.5 by 3.0 mm., sometimes 150 or more cells in a gall. On or involving young stems, new clusters of leaves, and especially the flower clusters.

**Agamic Generation:** The larval cell occupying most of a triangulate or obconical capsule, somewhat compressed, up to 5. by 4. mm. in dimensions, one to six, usually one, between the nut and the cup of the acorn; on all of the black oaks which bear the bisexual generation.

**RANGE.**—Ottawa to Virginia, Texas, and Illinois. Probably throughout more eastern North America wherever black oaks occur.

The varieties I treat for this species are on a whole more nearly related than are the varieties of most Cynipidæ. There is enough individual variation to make it difficult to definitely determine every individual. Nevertheless series of each variety average rather differently, and material of any variety from separated localities agrees well in its characters.

My first examinations happened to involve material from several oaks, each oak from a different locality. I should have believed the variation in the insects was due to their isolation upon distinct hosts. But three different hosts at Rosslyn, Virginia, give the same insect. The objections to believing each variety restricted to a distinct faunal area are that I have two varieties from Rosslyn, and that the ranges as far as known are intricately connected, at least for three of the varieties. However I rather expect to find that each variety is restricted to a geologically distinct area. Our records are still so few that it is quite possible my present interpretations of this species will need revision, but I hope that the facts have been so distinguished from my hypotheses that others may be able to build on my work.

This species is famous as the first for which an alternation of generations was proved. One generation occurs in large, woolly galls, is bisexual, appears early in the spring, and matures within a couple of months or less. The sexes are probably produced in about equal numbers; of 898 insects of all varieties which we have bred, 447, or just about 50 per cent, are males. These data are not wholly significant, however, because sometimes only a single sex is produced in each gall. Patterson found this for a gall of *austrior*, and collections of other varieties in several museums usually present only one sex. Unless a considerable number of galls are used for breeding, the sexes may be obtained in unequal num-



bers. From 44 galls of variety *consobrinus* I obtained 70 per cent males; and Patterson obtained 90 per cent males for *austrior*! This bisexual generation lays fertilized eggs in year-old acorns, the next generation produces a naked, seed-like, acorn gall, is agamic, and takes two or more years to develop. Superficially the insects and galls of the two generations are so different that this has appeared as extreme a case of heterogeny as we knew. The differences, I now realize, are largely superficial. Upon making the comparative descriptions of the insects I find that they differ in only a relatively few respects; it has been simple to make a description which would cover either generation of the species. Upon further examination, especially of younger stages of the galls, I find that they are much the same except for one being naked and on the acorn, while the other has a woolly covering and occurs on young stems, leaves, or flowers, but both have at center similar seed-like capsules enclosing nearly as large larval cells. I have suggested (1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 373) that heterogeny in Cynipidæ is an extreme development of seasonal dimorphism. At that time I questioned whether one could ascribe the differences in the galls of the two generations of *operator* primarily to the differences in the plant tissues attacked; but now I am ready to believe such may be the case. If, as Cosens has shown (1912, Trans. Can. Inst., IX, p. 374), no new plant structures are developed in the formation of a gall, one should not expect the normally hairless acorn to produce as woolly a gall as the normally pubescent or hairy young stem, leaf, or flower tissues.

The agamic generation has been bred for only one variety, *operator*, but I have acorn galls which probably represent the agamic generations of every one of the varieties here described. The following references are to the bisexual forms of possibly undescribed varieties:

*Cynips q. operator* Walsh, 1864, Proc. Ent. Soc. Phila., II, p. 494. Thompson, 1915 (Walsh record), Amer. Ins. Galls, pp. 11, 30.

This species has further been recorded (Beutenmuller, 1913, Bull. Brook. Ent. Soc., VIII, p. 103) from Ottawa, and Pennsylvania. I do not know what varieties occur in these locali-

ties. I have material representing some further varieties, but it is not sufficient to warrant description now. Probably several other varieties remain to be described, particularly from more southern regions of North America.

*Operator* does not belong to the genus *Andricus* in its true limitations. *Operator* has unique generic characters which I have not yet recognized in any other species. Until a complete revision of cynipid genera can be given, it is not desirable to introduce a new genus for this species.

***Andricus operator* variety *operator*  
form *operator* (Osten Sacken)**

*Cynips quercus operator* Osten Sacken, 1862, Proc. Ent. Soc. Phila., I, p. 256.

*Cynips q. operator* Bassett, 1863, Proc. Ent. Soc. Phila., II, p. 332; 1864, Proc. Ent. Soc. Phila., III, pp. 197, 198; 1873, Can. Ent., V, pp. 91, 93, 94; 1877, Can. Ent., IX, p. 121. Riley, 1873, Amer. Nat., VII, p. 519. Howard, 1882, Psyche, III, p. 329. Packard, 1890, 5th Rpt. U.S. Ent. Comm., p. 11.

*Cynips operator* Osten Sacken, 1865, Proc. Ent. Soc. Phila., IV, pp. 341, 346, 350, 357.

[No name] Bassett, 1880, Can. Ent., XII, p. 170.

*Andricus (Callirhytis) operator* Mayr, 1881, Gen. Gallenbew. Cynip., p. 28. Bassett, 1882, Amer. Nat., XVI, p. 246. Ashmead, 1885, Trans. Amer. Ent. Soc., XII, p. 294. Ashmead (in Packard), 1890, 5th Rpt. U.S. Ent. Comm., p. 105. Viereck, 1916, Hymen. Conn., p. 429.

*Callirhytis operator* Ashmead, 1885, Trans. Amer. Ent. Soc., XII, p. 304; 1887, Trans. Amer. Ent. Soc., XIV, p. 131. Ashmead (in Packard), 1890, 5th Rpt. U.S. Ent. Comm., p. 110. Riley, 1895, Sci., I, p. 463. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 66. Thompson, 1915 (O. S. record), Amer. Ins. Galls, pp. 11, 30. Felt, 1918, N.Y. Mus. Bull., 200, p. 72.

*Andricus operator* Dalla Torre, 1893, Cat. Hymen., II, p. 92. Bassett, 1900, Trans. Amer. Ent. Soc., XXVI, p. 315. Felt, 1906, Ins. Aff. Pk. and Woodl. Trees, II, pp. 618, 622, 713. Britton, 1920, Conn. Geol. and Nat. Hist. Surv. Bull., 31, p. 321.

*Callirhytis quercus-operator* Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 582, 798, 830.

**FEMALE.**—Differs from the bisexual females of the other varieties of the species as follows: Head and thorax bright brownish rufous, face yellow rufous, antennæ mostly yellow rufous, slightly darker terminally, parapsidal grooves distinctly wide posteriorly, not quite smooth at bottom, convergent posteriorly; foveæ quite broad, entirely rugose at bottom; mesopleuræ distinctly aciculate centrally; abdomen usually bright rufous basally; length 1.5-2.7 mm.

MALE.—Shows the secondary sexual characteristics of the species but further agrees with the female of this variety.

GALL.—Similar to galls of the bisexual generations of the other varieties. On *Quercus marylandica*, *Q. coccinea*, and possibly other black oaks.

RANGE.—Virginia: Rosslyn. D.C.: Washington (Osten Sacken). New York; Sullivan County (Beutenmuller collector). Connecticut: Waterbury (Bassett). Possibly thruout a more northern area of eastern United States except in more northern New England and on the Atlantic Coastal Plain.

TYPES.—Females, males, and galls in the Museum of Comparative Zoology; a male in my collection. Washington, D.C.; *Q. marylandica*; Osten Sacken collector.

This variety is closely related to varieties *falsus* and *consobrinus*, from which this insect is to be distinguished by the distinctly broadened parapsidal grooves, the sculptured foveæ, and the distinctly larger size.

Osten Sacken originally described *operator* from *Q. marylandica* (= *Q. nigra* Gray, Ed. 6, not Linnæus). I have it from *marylandica* at Rosslyn, Virginia, altho most of the insects from that host are *consobrinus*. Insects I bred from galls of *Q. coccinea* at Rosslyn, material from an unidentified host in Sullivan County, New York, and Bassett material purporting to be from *Q. ilicifolia* near Waterbury, Connecticut, are quite uniformly of this variety. Apparently it occurs on several of the black oaks, without coincident, constant variations. In regard to coloration, material from each host may average rather differently, but I cannot discover good structural characters to separate host varieties. The distribution appears to be broad, over a part of eastern United States, but we need more data to determine the exact range. I have not seen it from more northern New England, from the Atlantic Coastal Plain, nor from Texas, altho other varieties occur in those places. Its occurrence at Rosslyn, Virginia, in the same locality with *consobrinus*, may indicate a limit of its range. The British Columbia record of Dalla Torre and Kieffer originated in their customary, mistaken interpretation of "D.C." The Bassett material, unfortunately, is not of certain locality or host, for Bassett did not definitely label most of his material and sometimes put into a single box unmounted material from several sources. Whether the *operator* material I have seen is the same as Bassett had when

he recorded *Q. ilicifolia* and *Q. palustris* as the hosts, and when he solved the life history, identifying *operatola* as the agamic generation, I cannot be certain until I can see material certainly collected at Waterbury.

***Andricus operator* variety *operator*  
form *operatola* (Bassett)**

*Cynips q. operatola* Riley, 1873, Amer. Nat., VII, p. 519.

*Callirhytis operatola* Riley, 1895, Sci., I, p. 463. Thompson, 1915, Amer. Ins. Galls, pp. 21, 30 (not the fig.).

*Andricus operatola* Bassett, 1900, Trans. Amer. Ent. Soc., XXVI, p. 315 [Adult first described!]. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 64; 1910, Das Tierreich, XXIV, pp. 550, 823, 831. Beutenmuller, 1913 (in large part), Brooklyn Ent. Soc. Bull., VIII, p. 103, fig. 8. Viereck, 1916, Hymen. Conn., p. 418. Britton, 1920, Conn. Geol. and Nat. Hist. Surv. Bull., 31, p. 321.

*Andricus operator* form *operatola* Felt, 1906, Ins. Aff. Pk. and Woodl. Trees, II, p. 709. Kinsey, 1920 (except the figs.), Bull. Amer. Mus. Nat. Hist., XLII, pp. 347, 380.

*Andricus operator* Felt, 1918, N.Y. Mus. Bull., 200, p. 118 (not the fig.).

**FEMALE.**—Differs from the female of the bisexual generation of this variety as follows: Head and thorax rich brownish rufous, darker in part; antennæ thicker, uniformly rich brownish rufous; anterior parallel lines more evident, in part because of a darker coloring; scutellum not as long as wide; foveæ moderately broad, not rounded, sparingly sculptured at bottom; abdomen rich rufous to piceous dorsally and posteriorly, smooth, the edges of the segments finely punctate, the second segment rather hairy latero-basally, the abdomen much longer than high, rather produced dorsally, the edges of the segments strongly oblique; legs golden rufous, the tibiæ, especially the hind tibiæ, brown; areolet small or closed, indistinct; length, 3.2-3.5 mm.

**GALL.**—Similar to the seed-like acorn gall of the other agamic forms. Probably on all of the black oaks on which the bisexual generation occurs.

**RANGE.**—As given for the bisexual form of this variety. Probably thruout a more northern part of the eastern United States except in more northern New England and on the Atlantic Coastal Plain.

In an earlier paper (1920), I have given an account of this form; as explained under *operator* there may be a question whether this is the agamic form of *operator* or of *falsus*. The insect matures in the second or third spring, emerging in early May in Connecticut, and oviposits in the young buds to produce the bisexual generation.



**Andricus operator** variety **consobrinus**, new variety  
form **consobrinus**, new form

**FEMALE.**—Differs from the bisexual female of variety *operator* as follows: Parapsidal grooves very slightly widened posteriorly, almost smooth at bottom; foveæ rather large, round, sparingly roughened at bottom; mesopleuræ finely aciculate centrally; abdomen yellow rufous basally; length 1.2-2.0 mm.

**MALE.**—Shows the secondary sexual characteristics of the species, and further agrees with the female of this variety except in having most of the abdomen a brownish piceous, and in being smaller, 1.2-1.7 mm.

**GALL.**—Similar to the woolly gall of the other varieties. The types are small, averaging 20. mm. in diameter, the hairs rather brittle and light brown; but more mature galls may differ. On the young stems and aments of *Quercus velutina*, *Q. marylandica*, and *Q. coccinea*.

**RANGE.**—Virginia: Rosslyn. Probably thruout a more southern range in eastern United States.

**TYPES.**—59 females, 140 males, 44 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females, males, and galls at the U.S. National Museum, Stanford University, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Roslyn, Virginia; May 16, 1920; *Q. marylandica*; Kinsey collector.

The insects emerged at some time after collecting on May 16, 1920. The galls appeared immature at the time of collecting. This variety comes nearest *austrior*; the galls are similar; the males differ more than the females.

The types of *operator* were collected on *marylandica* in the District of Columbia, which is very near Rosslyn, Virginia. Nevertheless only 3 of the 202 insects I secured from *marylandica* at Rosslyn are *operator*. The others, representing *consobrinus*, have the parapsidal grooves much more narrow posteriorly, smoother foveæ, and are much smaller in size. It may prove that two varieties occur in two distinct faunal areas which meet near Washington. One of the 48 insects I obtained from *Q. coccinea*, and all of the 12 I bred from *Q. velutina* from Rosslyn are *consobrinus*. I cannot discover any constant differences between this material from the several oaks.

**Andricus operator** variety **austrior**, new variety  
form **austrior**, new form

**FEMALE.**—Differs from the bisexual female of variety *operator* as follows: Parapsidal grooves fine, fine posteriorly, smooth at bottom; foveæ narrow, shallow, sparingly sculptured at bottom; mesopleuræ

finely, faintly aciculate centrally; abdomen yellow rufous basally; the hind tibiæ dark brown to almost black; length 1.7-2.2 mm., averaging smaller than in *operator*.

MALE.—Shows the secondary sexual characteristics of the species, and further differs from the female of this variety as follows: Face dull yellow, antennæ dull yellow, only the basal segment brownish; the third segment almost half again as long as the fourth; thorax dull yellowish rufous; legs dull yellowish, the hind femora and tibiae sometimes brownish; length 1.2-2.0 mm., averaging less than in the female.

GALL.—Similar to the woolly galls of the other varieties; white, weathering light brown in part; 15.-25. mm. in diameter, usually irregular in shape. On young twigs (from the bud) of *Quercus Schneckii*.

RANGE.—Texas: Austin. Possibly confined to an area including eastern Texas, on black oaks.

TYPES.—18 females, 125 males, 3 galls. Holotype female, paratype females, males, and gall at The American Museum of Natural History; paratype females, males, and galls with the author; paratype females and males at the U.S. National Museum and Stanford University; paratype males at the Museum of Comparative Zoology and the Philadelphia Academy. Labelled Austin, Texas; April 24, 1921; *Q. Schneckii*; Patterson collection number 64.

Patterson first found this gall on April 1, 1921; it had not been observed before that date, but pupæ were forming in the galls at the time. This indicates a very rapid development of the young gall. Adults began emerging April 24. From a single gall Patterson bred 128 males and no females; a single gall sometimes produces only a single sex.

This insect is more closely related to variety *consobrinus* than to the other varieties. Thus far we have obtained it only from *Q. Schneckii*; other black oaks in the same region may support this variety, or may have isolated still other varieties. We have galls of an agamic form of this species from Austin on *Q. marylandica* (Patterson collection 144); whether these represent the alternate generation of *austrior* I cannot say until we can obtain insects.

***Andricus operator* variety *falsus*, new variety  
form *falsus*, new form**

*Callirhytis operator* Beutenmuller (in Smith), 1910, Ins. N.J., p. 601. Thompson, 1915 (R.I. record), Amer. Ins. Galls, pp. 11, 30, pl. 2, fig. 169.

*Andricus operator* form *operator* Kinsey, 1920 (in small part), Bull. Amer. Mus. Nat. Hist., XLII, p. 345, pl. XXXI, fig. 32.

FEMALE.—Differs from the bisexual female of variety *operator* as follows: Parapsidal grooves moderately wide posteriorly, smooth at bot-

tom, more convergent posteriorly than in *illustrans*; foveæ quite broad, rounded, almost wholly smooth at bottom; mesopleuræ quite finely aciculate centrally; abdomen reddish rufous basally; length 1.7-2.2 mm., less than in *operator*.

MALE.—Shows the secondary sexual characteristics of the species, and further agrees with the female of this variety; length 1.5-2.0 mm.

GALL.—Similar to the galls of the bisexual forms of the other varieties; large, up to 55. mm. in diameter, becoming golden brown on aging; on *Quercus ilicifolia*.

RANGE.—Rhode Island: Providence (Thompson). New York: Staten Island (Beutenmuller and W. T. Davis). New Jersey: Plainfield, New Brunswick, Milltown, Hornerstown (in Amer. Mus. Nat. Hist.). Possibly confined to a northern part of the Atlantic Coastal Plain.

TYPES.—14 females, 1 male, 4 galls. Holotype female, paratype females, males, and galls at The American Museum of Natural History; paratype females and gall with the author. Labelled Staten Island, New York; June, 1893; *Q. ilicifolia*; Beutenmuller collector.

*Falsus* is to be recognized by the only moderately widened parapsidal grooves, the smooth, rounded foveæ, and the small size. On the whole this variety more nearly agrees with the other southern varieties than it does with *illustrans*, the more northern form on *Q. ilicifolia*. I have examined insects of *falsus* from the localities listed, and find them quite uniform. The Bassett material purporting to be from *ilicifolia* at Waterbury, Connecticut, belongs to variety *operator*. Certainly two varieties, *falsus* and *illustrans*, occur on this one oak, and possibly the third, *operator*. The geologic histories of the distinct areas occupied by each variety may be responsible for the development of the distinct insects. I do not know whether other black oaks in the same part of the Coastal Plain have this same variety.

The galls which I figured (1920, Bull. Amer. Mus. Nat. Hist., XLII, pl. XXXI, figs. 30, 31), are from *ilicifolia* near Providence, Rhode Island, and probably represent the under-scribed, agamic form of *falsus*.

**Andricus operator** variety **illustrans**, new variety  
form **illustrans**, new form

*Callirhytis operator* Stebbins, 1910, Springfield (Mass.) Mus. Bull., II, p. 25, fig. 47. Thompson, 1915 (Mass. record), Amer. Ins. Galls, pp. 11, 30.

*Andricus operator* form *operator* Kinsey, 1920 (in large part), Bull. Amer. Mus. Nat. Hist., XLII, pp. 345, 380.

**FEMALE.**—Differs from the bisexual females of the other varieties of the species as follows: Head and thorax rather dark rufous brown, antennæ entirely light brownish rufous; parapsidal grooves rather wide posteriorly, averaging distinctly finer than in *operator*, almost smooth at bottom, averaging less convergent at the scutellum than in any of the other varieties; median groove short but often more evident than in other varieties; foveæ rather broad, distinctly sculptured at bottom; abdomen red rufous basally; legs light brownish rufous, darker basally, the posterior tibiæ dark brown to black; length 2.0-2.5 mm., smaller than *operator*.

**MALE.**—Shows the secondary sexual characteristics of the species, and further agrees with the female of this variety.

**GALL.**—Similar to the galls of the other bisexual forms; large, weathering a golden brown. On *Quercus ilicifolia*.

**RANGE.**—New Hampshire: West Ossipee. Massachusetts: Springfield (Stebbins); Worcester? (Thompson); Boston (Clarke); Sharon, Blue Hills. Probably only in more northern New England.

**TYPES.**—About 150 females, 100 males, 2 galls. Holotype female, paratype females, and males at The American Museum of Natural History; paratype females and males at the U.S. National Museum, Stanford University, the Museum of Comparative Zoology, the Philadelphia Academy, and the Boston Society of Natural History; adults and galls with the author. Labelled Blue Hills, Massachusetts; June 9 to 30, 1918; *Q. ilicifolia*; Kinsey collector.

The galls of this form are very abundant on the scrub oaks in eastern Massachusetts, early in the spring as soon as the flowers begin to appear. They are very succulent, drying quickly unless gathered after the first of June. Insects emerge thruout June and early in July.

Following the previous practice which overlooked varietal differences, I described this insect in 1920 as the bisexual form of *operator*. The insect up to date is known only from *ilicifolia*; it may occur also on other black oaks in the same region. *Ilcifolia* is also one of the hosts of variety *operator* in another faunal area, and of *falsus* in still another area. I have seen insects only from Sharon and the Blue Hills, but the variety may range thruout northern New England, at least wherever *ilicifolia* occurs. This variety is rather distinct from any of the other described varieties of the species, which emphasizes the fact that we have been overlooking data when they occur too near the centers of our more extensive work with Cynipidæ, the northeastern parts of the United States!

The acorn gall of the agamic generation is abundant on *ilicifolia* in the range of this variety, but I have not yet obtained the adult. I have collected this acorn gall as far north



as West Ossipee, New Hampshire. The gall figured by Stebbins (1910, Springfield Mus. Bull. II, p. 26, fig. 48), may belong to this undescribed form.

### *Andricus ovatus* (Weld)

FEMALE.—A mostly uniform shade of rufous; mesothoracic grooves and lines not wholly straight; second abdominal segment small; length averaging 4.0 mm. HEAD: Slightly broader than the thorax, distinctly enlarged behind the eyes; rufous or darker, the mouth parts still darker; very irregularly roughened, rugose and hairy on the face and cheeks. Antennæ short, rather thick; with 14 segments, second segment distinctly elongate, the third not much longer than the fourth, the last rather longer than the preceding. THORAX: Rufous or darker; mesonotum shagreened, very irregularly roughened antero-laterally; parapsidal grooves distinct but not deep, continuous to the pronotum, very narrow and somewhat obscured by the sculpturing anteriorly, almost smooth at bottom, gradually converging posteriorly, sharply diverging at the very anterior end; median groove distinct for two-thirds or more of the distance to the pronotum, widest posteriorly, shallow, not wholly straight, not quite smooth at bottom; anterior parallel lines shallow grooves, distinct, not wholly straight; lateral lines shallow grooves, smoother, long, not straight; scutellum longer than wide, somewhat squared posteriorly, slightly depressed medio-posteriorly; rugose, hairy, with the two large, broad foveæ broader laterally, smooth, slightly ridged at bottom; pronotum laterally rugose; mesopleuræ smoothest beneath the tegulæ, elsewhere very closely rugoso-aciculate. ABDOMEN: Rufous or darker, smooth, microscopically punctate except on the base of the second segment, naked except for a very few hairs latero-basally; not much longer than high, not produced dorsally, the edges of the segments only slightly oblique but well rounded ventrally, the second segment covering about half the abdomen; ventral spine rather short, rather slender and pointed. LEGS: Irregularly roughened, hairy; the tarsal claws rather weak, simple. WINGS: Mostly clear, tinged brownish in part, especially in the radial, discoideal, and cubital cells; not ciliate on any of the margins except on the hind margins of the hind wings; veins brown, only the subcosta and cross veins heavy; areolet of moderate size or small; cubitus discontinuous; radial cell rather long and broad, open, the second abscissa of the radius clearly curved; the first abscissa angulate, not sharply so, without a projection, very limitedly infuscated. LENGTH: 2.8-4.8 mm., averaging nearer 4.0 mm.

GALL.—Elliptical, hollow, standing out from the bark of roots. Monothalamous, altho several galls may more or less solidly fuse. Each gall globoid to ovoid or egg-shaped, up to 4. mm. in diameter by 6. mm. long, usually smaller, covered with bark mostly of normal color and texture, somewhat smoother; a direct continuation of the root bark, altho the galls stand out distinctly from the bark; a large, circular exit hole terminally. Internally entirely hollow (in mature galls), the walls moderately thin, a distinct woody lining inside of the bark wall.

On very large roots or on rootlets not 2. mm. in diameter; on black oaks.

RANGE.—Florida to Texas.

This is a very distinct root gall. The insects pupate late in the fall, soon becoming adults, but not emerging until early in the spring.

The three varieties I have seen are distinct as to color, two of them remarkably so. It has been a mistake to completely ignore variation in color as tho occurring without order in any group of individuals. These color differences are correlated with very definite morphologic characters, and with host and geographic distribution. It is too much to expect one variety to become the next if transplanted from one oak to another or one locality to another. But host and geographic isolation have separated distinct forms in this species. The galls of all of the varieties are very similar.

### ***Andricus ovatus* variety *ovatus* (Weld)**

*Callirhytis ovata* Weld, 1921, Proc. U.S. Nat. Mus., LIX, p. 222, pl. 34, fig. 23.

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color of head, thorax, and abdomen bright brownish rufous; antennæ light brownish rufous, the last seven or eight segments browner; parapsidal grooves of moderate width at the scutellum, not as broad nor as rugose at bottom as in *melanicus*, not converging as closely posteriorly; anterior parallel lines rather close together anteriorly for almost half the length, almost twice as wide apart posteriorly; the scutellum relatively shorter, the foveæ large, broad, broader laterally, mostly smooth at bottom, separated by a fine, simple ridge; mesopleuræ beneath the tegulæ smoother, irregularly roughened; legs entirely brownish rufous, including the coxæ; areolet rather small.

GALL.—Quite the same as those of the other varieties; on *Quercus Catesbæi*.

RANGE.—Florida: Marianna, Ocala, Madison, Jacksonville (Weld).

TYPES.—Holotype and paratype adults and galls at the U.S. National Museum; paratype adults in my collection. U.S. National Museum number 22569; from Marianna, Florida; *Q. Catesbæi*; Weld collector.

Weld recorded having collected the type galls on October 11, 1919, when they contained pupæ; living adults were cut out of these galls on December 3. Empty galls were found at Ocala on April 15, 1914. Probably emergence occurs late in January or in February, as with *melanicus*. Weld further

suggests that inasmuch as the December galls contained larvæ as well as pupæ emergence may be distributed over two years. Altho Patterson cut into a great many of the galls of *melanicus* he found no indication there of differences in emergence.

This variety is readily distinguished from *melanicus* by the lighter color and the distinctly narrower parapsidal grooves; from the variety on *myrtifolia* it is best distinguished by the anterior parallel lines which diverge posteriorly and the foveæ which are much broader and wholly smooth.

The galls which Weld recorded from Daytona, Florida, occurring on *Quercus myrtifolia*, and which were also included in the paratypes of *ovatus*, belong to a distinct variety.

### ***Andricus ovatus* variety *melanicus*, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color of head, thorax, and abdomen dark chestnut rufous; antennæ almost entirely brown, very dark terminally, the first two segments rich rufous; parapsidal grooves distinctly broader and more rugose at the scutellum than in *ovatus*, converging more closely posteriorly; anterior parallel lines rather close together anteriorly for almost half the length, almost twice as wide apart posteriorly; the scutellum relatively much longer, the foveæ large, broad, broader laterally, mostly smooth but irregularly ridged at bottom, separated by a wider rugose area than in *ovatus*; mesopleuræ beneath the tegulæ very finely puncto-rugose, front and middle pairs of legs rich rufous, tibiæ lighter, hind legs very dark rufo-piceous, sometimes in part black, the tibiæ lighter; areolet of moderate size.

GALL.—Quite the same as those of the other varieties; more often fused to the very tips; on *Quercus Schneckii*.

RANGE.—Texas: Austin.

TYPES.—55 females, 16 galls (in 3 clusters). Holotype female, paratype females, and galls at The American Museum of Natural History; paratype adults and galls with the author; paratype adults at the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and Stanford University. Labelled Austin, Texas; February 7, 1922; *Q. Schneckii*; Patterson collection number 156.

Patterson found adults emerging on February 7, 1922.

This variety is readily distinguished at a glance by its dark color; it is distinguished from both other varieties by the much broader parapsidal grooves which converge more closely posteriorly; and it is further distinct from the variety on *myrtifolia* in having very broad, largely smooth foveæ.

In describing *ovatus* Weld recorded collecting similar galls

on *Quercus texana* at Boerne, Texas. I cannot say what variety these insects may be, especially as they come from an oak different from but closely related to the host of *melanicus*.

### ***Andricus pomiformis* (Bassett)**

FEMALE.—Head and thorax black, coarsely sculptured; foveæ large, a dark cloud at the base of the radial cell; length over 3.0 mm. HEAD: Fully as wide as the thorax, rather distinctly enlarged behind the eyes; black, the mouthparts rather dark rufo-piceous, tips of mandibles piceous; entire head coarsely, rugosely sculptured, striæ radiating from the mouth; face and cheeks rather densely hairy. Antennæ light brownish rufous, lightest basally, darker terminally; heavily pubescent; with 14 segments, the second globose, the third not much longer than the fourth, the last not half again as long as the preceding, sometimes with an indication of a division near the tip. THORAX: Wholly black, tinged rufo-piceous in old specimens; not densely covered with yellow hairs; mesonotum coarsely sculptured; parapsidal grooves continuous, sometimes in part lost in sculpturing; median groove more or less lost in the sculpturing; anterior parallel lines fine, in some varieties indistinct and discontinuous; lateral lines raised, smooth, of moderate length; scutellum as coarsely sculptured as the mesonotum, sometimes medianly depressed, somewhat as in the genus *Amphibolips*; basal foveæ large, broad, mostly smooth at bottom, rather semicircular in shape, separated by only low sculpturing; pronotum laterally rugoso-aciculate; mesopleuræ rugose, hairy, with a smooth, shining area centrally. ABDOMEN: Rich rufo-piceous to piceous-black, becoming more rufous in old specimens, darkest dorsally, lightest ventro-posteriorly; smooth, shining, finely but closely punctate except on the basal half of the second segment, naked except for rather dense patches of hairs latero-basally; narrow, elongate, protruding dorsally, edges of segments sharply oblique, well rounded ventrally, the second segment covering three quarters or more of the entire area; ventral spine very slender, hairy, of moderate length, ventral valves at least at a 45° angle. LEGS: Light brownish rufous, all the coxæ and the hind trochanters piceous black, the tips of the tarsi dark, the hind femora and tibiæ rich rufous brown; legs punctate and rather densely hairy; tarsal claws of moderate weight, simple, with a bare suggestion of a tooth basally. WINGS: Clear, ciliate on all margins, the veins brown; areolet of different sizes; cubitus fine, not reaching the basalis; radial cell entirely open, moderately wide, the second abscissa of the radius only slightly curved; the first abscissa rather angulate, heavy, with a heavy, moderately large, brown patch between the first abscissa of the radius and the terminal portion of the subcosta. LENGTH: 3.0-4.0 mm.

GALL.—Spherical, smooth, compact, in section suggesting an apple with seeds about the core. Polythalamous, often with fifty or more larval cells. More or less perfectly spherical, rarely flattened, or elongate ovate; of all sizes up to 55. mm., averaging nearer 40. mm. in diameter; the surface sometimes entirely smooth, usually finely, irregularly pitted



and cracked, sometimes set with low, raised lines or irregular rows of low tubercles radiating more or less from the slightly pointed tip of the gall; brilliant, rich apple red when fresh, with some apple green and lighter green, becoming bright brownish yellow on aging, weathering darker. Internally like compacted sawdust, crystalline, spongy only in old and weathered specimens; with a hard, woody core originating from the point of attachment, the core flaring and somewhat branching in the center of the gall, with the larval cells arranged radiantly in the extremities of this core, mostly in a single layer centrally of the gall; each cell averaging 2. x 4. mm., with a distinct and easily separable, thin-walled lining. Laterally, less often terminally, attached by a small point, sessile on twigs of *Quercus agrifolia* and *Q. wislizenii*.

RANGE.—California: from the Mexican border to Dunsmuir and Ukiah.

This is one of the most prominent of Californian galls, being surpassed in size and abundance only by *Andricus californicus*. Both species are known as oakapples. As with *californicus*, the possibility of more than one variety, each with its own intensely interesting biologic problems, has been heretofore entirely overlooked. The biologist who will learn what these two species should easily disclose in ten years or less work on the field, may contribute as important data as we yet possess on such problems as the nature of alternation of generations, distribution factors, and host effects, for instance.

Adults mature in early spring, earlier at southern localities. The field data indicate that northern varieties (see variety *pomiformis*) complete the life cycle in a year, with the possibility of an alternation of generations; while southern varieties (see *maculipennis*) take two years or more to mature, and may not have an alternate generation. This must be considered a suggestion, to be verified only by experimental work. If this is shown to be the true condition, it confirms my previously expressed opinion (1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 372) that alternation of generations is an extreme development of seasonal dimorphism.

If galls are collected too soon before maturity, the larvæ will develop into adults altho few insects will emerge. One finds this the case with galls in the laboratory more often than with galls in the open. Under adverse conditions in the field, such as a season of drought, there may be a similar destruction of adults before emergence. An experience with this species in the laboratory alone, in connection with some

other similar cases, misled me into an over-statement in a previous paper (1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 383) as to the lack of vitality of Cynipidæ in general.

Some of the most illuminating data I yet have on the effectiveness of the host in isolating varieties is that presented under variety *distinctus*.

Some of the varieties of this species show a median depression of the scutellum much as in the genus *Amphibolips*. Other varieties do not show this. An evolution of a generic character has occurred within this single species.

*Callirhytis rossi* Kieffer (1903, Marcellia, II, p. 84, figs. 1, 2) is probably the same as one of the varieties described for this species in this paper. The publication was made without a more definite locality than "California", and without a host determination, but with a host description which best fits *Quercus chrysolepis*. I feel certain there must be a mistake here, just as I do not believe Kieffer's *eriphorus* came from *Wislizenii* as published. Until we can see types of *rossi* it will not be possible to determine the variety it represents. I am inclined to expect to find it a synonym of *maculipennis*.

### **Andricus pomiformis** variety **pomiformis** (Bassett)

*Cynips Q. pomiformis* Bassett, 1881, Can. Ent. XIII, p. 74.

*Andricus pomiformis* Ashmead, 1885, Trans. Amer. Ent. Soc., XII, pp. 295, 300, 303; 1887, Trans. Amer. Ent. Soc., XIV, p. 130. Ashmead (in Packard) 1890, 5th Rpt. U.S. Ent. Comm., p. 108. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 64. Beutenmuller, 1904, Bull. Amer. Mus. Nat. Hist., XX, p. 24. Thompson, 1915, Amer. Ins. Galls, pp. 8, 33.

*Callirhytis pomiformis* Mayr, 1902, Verh. Ges. Wien, LII, p. 289. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 82. Felt, 1918, N.Y. Mus. Bull., 200, p. 62. Fullaway, Ann. Ent. Soc. Amer., IV, p. 371.

*Callirhytis quercus-pomiformis* Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 568, 803, 825. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 355; 1912, Journ. N.Y. Ent. Soc., XX, p. 275.

FEMALE.—Shows the following characteristics in addition to those common to all varieties of the species: Parapsidal grooves very largely lost in the sculpturing; wholly rugose at bottom; no median depression even indicating a median groove; anterior parallel lines fine, smooth, continuous, fairly distinct; lateral lines rather prominent, distinctly wider than in *maculipennis*; mesopleuræ with the smooth central area wholly smooth and naked; foveæ separated only by a very low rugose area; areolet moderately small to very small; the cloud on the first abscissa of the radius of moderate size, smaller than in *maculipennis*.

GALL.—Very much like that of all other varieties except *distinctus*; the surface smooth. On *Quercus agrifolia* (and *Q. Wislizenii*?).

RANGE.—California: San Francisco? (Bassett); Stanford University (Fullaway); Mt. Diablo (F. A. Leach coll.); Palo Alto, Salinas, Gilroy (Redwood School). Probably restricted to a region in central California.

TYPES.—Adults and galls at the Philadelphia Academy, The American Museum of Natural History, and the Museum of Comparative Zoology. From San Francisco (?), California; H. D. Bassett, collector; on *Quercus agrifolia*.

Bassett recorded this variety as emerging in March. None of the galls which I collected after March 8 contained adults, and fresh galls had not yet appeared in more northerly localities by April 1. The variety may require only a year to mature, in contrast to the history of southern varieties which may take up to three years to mature. An alternate generation is entirely possible for this variety.

The original host was *Quercus agrifolia*, and in the southern part of the range, nearer the coast, *agrifolia* is the only host. In the northern Coast Range, at least in Mendocino County, and in the Sierras north of El Portal, *agrifolia* does not occur, but there *Wislizenii* bears a similar gall. In addition *Wislizenii* bears a shaggy-coated gall similar to the southern variety *distinctus*. I have this latter gall from Placerville, Auburn, Oroville, and Ukiah, but I do not have adults enough of either smooth or shaggy galls from these localities to make definite determinations. As I suggest in the detailed discussion under *distinctus* it is possible that *pomiformis* takes to *Wislizenii* where *agrifolia* is lacking, and meeting a variety representing *distinctus* in the north sometimes interbreeds with it.

### ***Andricus pomiformis* variety *maculipennis* (Kieffer)**

*Callirhytis maculipennis* Kieffer, 1904, Bull. Soc. Metz, (2), XI, p. 131; 1904 (in Baker), Invert. Pacif., I, p. 42. Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 587, 808, 825. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 358. Felt, 1918, N.Y. Mus. Bull., 200, p. 76. Johnson and Ledig, 1918, Pomona Coll. Journ. Ent. and Zool., X, p. 26.

?*Callirhytis* Rossi Trotter, 1910, Boll. Lab. Portici, V, p. 110.

*Cynipide*, 31, Trotter, 1910, Boll. Lab. Portici, V, p. 112, pl. I, figs. 5, 6.

*Andricus pomiformis* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 383.



FEMALE.—Shows the following characteristics in addition to those common to all varieties of the species: Parapsidal grooves distinct but wholly rugose at bottom, most rugose anteriorly; no median depression even indicating the median groove; anterior parallel lines discontinuous, in part lost in the sculpturing; lateral lines fine, distinctly narrower than in variety *pomiformis*; mesopleuræ with the smooth central area scatteringly punctate and hairy; foveæ well separated; median depression of the scutellum only moderately deep; areolet of moderate size; the cloud on the first abscissa of the radius somewhat more extensive than in variety *pomiformis*, prolonged on the subcosta.

GALL.—Quite identical with the galls of all other varieties except *distinctus*; smooth; more often ridged and scatteringly set with short tubercles than in other varieties. On *Quercus agrifolia* (and *Q. Wislizenii*?).

RANGE.—California: Claremont (Baker); Descanso, Alpine, Fallbrook, El Toro, Upland, Pasadena; Los Angeles (Trotter); Santa Barbara, Gaviota, Paso Robles; El Portal (Trotter). Probably confined to more southern California, except in the San Bernardino and the Cuyamacas, wherever *Q. agrifolia* occurs, and possibly on *Q. Wislizenii*.

TYPES.—Berlin Museum? Cotypes at Pomona College. Material from the same collector (Baker) and the same locality (Claremont) at The American Museum of Natural History and Stanford University.

Collections made thruout February showed galls with the adults completely emerged; at the same time galls contained live larvæ and live adults, while fresh galls, not many days or weeks old, were on the trees. Both adults and live larvæ were found as late as February 1921 in galls which had been mature in February 1920. The insects must take at least two years, possibly longer to mature. Emergence comes early in the spring, and is followed so soon by the appearance of fresh galls that it suggests there is no alternation of generations with this variety, altho this question must be settled by experimental breeding.

This insect is not very abundantly distinct from variety *pomiformis*; it may be distinguished best by the finer lateral lines and the larger areolet. In regions where only *Q. agrifolia* occurs the variety is quite constant. It remains very constant in the Cuyamaca Mountains where it meets variety *descansonis* at Descanso. Where *maculipennis* meets *distinctus*, on *Wislizenii*, there is to be found a considerable amount of intergrading between the two insects. A gall from Santa Barbara gave adults with as large an areolet as in *distinctus*; this gall was recorded from *agrifolia*, but may have been on *Wislizenii* instead. A further discussion of these host considerations is given under *distinctus*.



**Andricus pomiformis variety distinctus**, new variety

FEMALE.—Shows the following characteristics in addition to those common to all varieties of the species: Parapsidal grooves distinct, rather smooth at bottom posteriorly, anteriorly wholly rugose; a distinct median depression, extending almost the length of the mesonotum, indicating the median groove; anterior parallel lines rather distinct, only in part discontinuous; lateral lines moderately fine; mesopleuræ with the smooth area wholly naked with almost no punctures; foveæ well separated by a rather higher rugose area; median depression of the scutellum rather distinct, not as deep as in *provincialis*; areolet large to very large, prolonged on the cubitus; the cloud on the first abscissa of the radius very large, larger than in any other variety, extending the full length of the terminal portion of the subcosta.

GALL.—Surface very much roughened, densely covered with projections, each ending in a short filament, making the gall appear very rough or even somewhat mossy; this shaggy coat largely breaks off of old galls. On *Quercus Wislizenii*.

RANGE.—California: El Portal, Merced Falls, Three Rivers, Pasadena, San Jacinto Mountains. This probably outlines the limits of the range.

TYPES.—8 females, 22 galls. Holotype female, paratype female, and galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, and with the author; galls at the Museum of Comparative Zoology and the Philadelphia Academy. Labelled Three Rivers, California; March 23, 1920; *Q. Wislizenii*; Kinsey Collector.

Very young galls were found at Three Rivers on March 23; at the same time galls possibly a year old had larvæ in them; some of these galls still contained live larvæ almost two years later, on February 11, 1922. However, some of the insects from these same galls had matured meanwhile. It may be that all of the larvæ would have transformed sooner if the galls had remained in the open, but it is not improbable that some individuals take longer than others to mature, remaining as larvæ for two or three years or even longer.

This variety is in all respects the most distinct in the species. The large areolet and the median depression of the scutellum define the variety in the region of the southern Sierras; there the shaggy-coated gall is also very characteristic. But in the Sierra Madre and other more southern parts of the range of the variety the galls are as smooth as in any other variety of the species, and altho some of the insects show all of the characteristics of the more northern material, others will show only a part of them, varying directly toward *maculipennis*. *Maculipennis* occurs largely in the same

region, in the same faunal area, but on another host, *Quercus agrifolia*. This variation in these cynipids exactly parallels the variations of the two oaks which are the hosts. As to the status of these two oaks Jepson states: (1910, Mem. Univ. Calif., II, pp. 230, 231), "While the two species are thus very distinct [in the north], frontier stragglers are not always readily separated. The leaves of the Coast Live Oak [*Q. agrifolia*] are sometimes quite flat [as is normal in *Wislizenii*] and the terminal winter buds on fruiting shoots of Interior Live Oak [*Q. Wislizenii*] may remain dormant so that full grown acorns may appear to be on 'one-year-old' wood [as is normal in *agrifolia*]. Acorns removed from the branch or picked from the ground are sometimes not determinable, so much do certain deep-cupped forms in the two species resemble each other. Nuts short and thick or as slender as a quill are not uncommon variants in *Quercus Wislizenii* acorns. These variations, which are to a large extent a matter of nutrition, are closely matched by similar variations in *Quercus agrifolia*. While the Interior Live Oak [*Wislizenii*] in tree form [as in the north] trespasses little if at all upon the Coast Live Oak or Encina [*agrifolia*] territory, it is found throughout the same region, overtopping it, as it were, on the summits of the mountains as a low shrub [as in the south]."

One explanation that may be offered is that *distinctus* has been segregated from other varieties by isolation upon a distinct host, much as geographic isolation would allow the development of distinct forms. In the Sierras where the hosts of the two are distinct, the two varieties do not interbreed, but at more southern points the two hosts, being more closely related, sometimes fail to effect the requisite isolation, and some degree of interbreeding may occur. A single gall from the many I collected near Santa Barbara gave adults which have an areolet fully as large as in any specimen of *distinctus*, tho in many respects the characters are those of *maculipennis*. I recorded this material as from *agrifolia*, but it is not impossible that I misdetermined a single tree of *Wislizenii*, since dwarfed specimens of the two oaks are so similar in the region.

In the northern Sierras, north of El Portal, in another faunal area, galls of this species occur on *Q. Wislizenii* which are sometimes shaggy as in variety *distinctus* and sometimes entirely smooth. Sometimes both forms occur in close prox-

imity on a single tree. I do not yet have insects enough to determine what varieties are represented here. Variety *pomiformis* occurs in the same faunal area, but was originally described from *agrifolia*. This oak is restricted to the coast country in the north, and does not occur in the northern Sierras. It is not improbable that variety *pomiformis* takes itself to *Wislizenii* where *agrifolia* is absent, that in so doing it comes into contact with a northern variety matching *distinctus*, and that the two may interbreed where they occur on the same host.

The San Bernardino variety on *Wislizenii* is separate from *distinctus*, and shows relations to *maculipennis* as much as to *distinctus*. In this range again *agrifolia* is not to be found.

### ***Andricus pomiformis* variety *provincialis*, new variety**

FEMALE.—Shows the following characteristics in addition to those common to all varieties of the species: Parapsidal grooves wider than in any other variety, but shallow and largely rugose; no trace of a median groove; anterior parallel lines discontinuous, in part lost in the sculpturing; lateral lines very fine; mesopleuræ with the smooth area wholly naked, with almost no punctures; foveæ larger, more elongate than in other varieties, not wholly smooth at bottom, separated by a shallow, rugose area; median depression of the scutellum deeper than in other varieties; areolet of moderate size to very small; the cloud on the first abscissa of the radius only moderately large.

GALL.—With a smooth surface; quite identical with that of all other varieties except *distinctus*. On *Quercus Wislizenii*.

RANGE.—California: San Bernardino mountains. Probably confined to the neighborhood of this range.

TYPES.—32 females, 14 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, and with the author. Labelled San Bernardino, California; January 31, 1920; *Q. Wislizenii*; Kinsey collector.

On January 31, 1920, galls showed that adults had emerged previously, but also contained live larvæ and adults.

The best characters for distinguishing this variety are the more elongate foveæ and the deeper median depression of the scutellum. Altho the variety occurs on *Wislizenii* it does not show closer relationship to the other varieties on that host than it does to the varieties on *agrifolia*. Of thirty-six individuals from the San Bernardino mountains, four are closer to *maculipennis* than to this variety. Many of the



others, however, vary toward *maculipennis*, and probably variety *provincialis* is not yet wholly separated from the other varieties, but there is a strong indication that a distinct type has been or is being isolated in the San Bernardino range.

***Andricus pomiformis* variety *descansonis*, new variety**

FEMALE.—Shows the following characteristics in addition to those common to all varieties of the species: Parapsidal grooves apparent but rugose at the bottom and largely lost in the mesothoracic sculpture; a very short but rather distinct indication of a median groove at the scutellum; anterior parallel lines fine, smooth, more or less continuous, but not as distinct as in variety *pomiformis*; lateral lines of moderate weight, finer than in variety *pomiformis*, heavier than in *maculipennis*; mesopleuræ with the smooth central area largely but not entirely free of punctures and hairs; foveæ separated by a very low rugose area, bottoms of foveæ somewhat rugose, at least in part; areolet very small or closed; the cloud on the first abscissa of the radius very limited, smaller than in any other variety.

GALL.—Similar to the galls of all other varieties except *distinctus*; smooth. On *Quercus agrifolia*.

RANGE: California. Descanso. Probably confined to a higher elevation of the Cuyamacas, extending into Lower California.

TYPES.—45 females, 4 galls. Holotype female, paratype females, and gall at The American Museum of Natural History; paratype females and galls with the author; paratype females at Stanford University, the Museum of Comparative Zoology, and the U.S. National Museum. Labelled Descanso, California; February 23, 1920; *Q. agrifolia*; Kinsey collector.

On February 23, 1920, galls contained large larvæ, while many insects had emerged previously.

This variety is readily distinguished by the very limited amount of shading on the first abscissa of the radius; the very small or closed areolet is a fairly constant character. Both this variety and *maculipennis* occur at Descanso, but none of the many adults which I have show intermediate or differently combined characters! Unfortunately I did not keep distinct the galls from Descanso, and those from higher elevations a few miles from Descanso; for I did not realize at the time that I was at the meeting point of two faunal areas. It may be that the two varieties are confined to different elevations. *Maculipennis* rather than *descansonis* is the variety at Alpine, not ten miles from Descanso, and over fifteen hundred feet lower in elevation. *Descansonis* is probably confined to higher elevations of the Cuyamaca Mountains



and their extensions into Lower California. This is another instructive instance of the nature of variation where two different faunal areas meet.

### **Andricus ribes, new species**

**FEMALE.**—Almost wholly black; mesonotum regularly shagreened; parapsides the only thoracic grooves; depression at base of scutellum undivided; abdomen about triagulate; a brownish cloud in the cubital cell. **HEAD:** Not as wide as the thorax; eyes protruding beyond the cheeks; black, the mandibles yellowish rufous; finely rugose, rougher on the face, with a few, scattering, short hairs. Antennæ brown, the basal four or five segments yellow-rufous, brightest basally; pubescent; with at least 14 segments (material broken), first segment short, second globose, third almost half again as long as the fourth. **THORAX:** Mesonotum black; regularly shagreened, almost naked of hairs; parapsidal grooves deep, continuous, gradually approaching closely at the scutellum, widely divergent only finally at the pronotum; median groove lacking; anterior parallel lines and lateral lines hardly indicated by smoother areas; scutellum black, distinctly longer than wide, moderately roughly rugose, a broad, smoother but not wholly smooth, slightly arcuate depression anteriorly not divided into foveæ; pronotum laterally finely rugose, irregularly aciculate posteriorly, hairy, usually black, sometimes with a rufo-piceous area; mesopleuræ usually black, very irregularly aciculate, hairy, a central area smoother, naked, sometimes colored rufo-piceous. **ABDOMEN:** Almost wholly black, sometimes tinged with dark piceous, ventral valves light rufo-piceous; almost naked, a few hairs latero-basally, and hairs on the ventral spine; abdomen about triangulate, slightly produced dorsally, the second segment covering two-thirds of abdomen. **LEGS:** Yellowish rufous, parts of hind coxæ may be piceous black, tarsi brownish apically; pubescent, tarsal claws fine, toothed. **WINGS:** Clear, ciliate on edge, veins heavy, deep brown; areolet of moderate size or smaller; cubitus not as heavy as the other veins, continuous to the basalis; radial cell open, the bounding veins not quite reaching the margin; second abscissa of the radius slightly curved, tip somewhat enlarged; first abscissa angulate, the angle about  $135^{\circ}$ , with a distinct infuscation; a limited, light brown cloud in the cubital cell, prolonged into a more or less discontinuous band parallel to the second abscissa of the radius. **LENGTH:** 2.2-2.8 mm.

**MALE.**—Very similar to the female, differing as follows: eyes somewhat larger; antennæ wholly brown; abdomen very slender, smaller, rather long-pedicellate.

**GALL.**—Spherical, berry-like, very succulent, green and more or less translucent when fresh, bright red when very young; the surface pebbled, with a few, small, projecting points. Shrivelling greatly upon drying, becoming blackened, 4-6. mm. in diameter; when drying upon the twig, the galls become rather obconical in shape, remaining lighter in color. Monothalamous, the cavity filling the whole gall, the wall of tissue moderately thin, thinnest furthest from the point of attachment.

Attached by only a slight point to twigs (bud galls) of *Quercus Douglasii*.

RANGE.—California: Oroville, Three Rivers.

TYPES.—16 females, 10 males, and 48 galls; adults all imperfect. Holotype female, paratype adults, and galls in The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, and with the author. Labelled Oroville, California; April 1, 1920; Kinsey collector.

Some of the galls at Oroville contained pupæ on April 1, while an equal number showed adults or exit holes thru which adults had already emerged. The whole life of this generation must be a month or so, with an alternate, probably agamic generation in the rest of the year. Of 40 adults I have, 14 are males. The species is not entirely unlike *Dryophanta pulchella* Beutenmuller, of which the male and gall are unknown, but the two species are distinct enough.

### *Andricus spectabilis* Kinsey

FEMALE.—Head and thorax black, densely hairy; abdomen rufous; areolet very large; cubitus not continuous; average length 4.5 mm. HEAD: Dark piceous to black, mandibles rufous; about as broad as the thorax, broadened behind the eyes; very finely coriaceous, punctate and hairy, dense with long hairs on the face, naked just lateral to the eyes; face with rugose striæ radiating from the mouth. Antennæ rufous brown to piceous; first segments and apical segments darker; hairy; with 14 (or 15) segments. THORAX: Black, piceous to black on the sides; mesonotum very finely coriaceous, closely punctate and densely hairy, with long hairs; parapsidal grooves distinct, punctate, slightly convergent at the scutellum, slightly divergent at the pronotum; median groove distinct and smooth for a short distance from the scutellum, obsolete forward; anterior parallel lines raised, smooth, extending from the scutellum about half the mesonotal length; scutellum black, longer than wide, deeply rugose, depressed on the median lines, with two large, shining, smooth or rugose, laterally-spreading foveæ at the base separated by a fine ridge; mesopleuræ piceous or black, in part coriaceous, almost naked of hairs. ABDOMEN: Rufous to piceous, brightest at the very base and apically, especially ventrally; practically smooth, the posterior segments, the ventral spine, and the valves with long hairs; only a few, scattering, long hairs at the base of the second segment laterally; longer than wide, the second segment covering less than one-third of the total area, the third segment fully as long as the second, the hypopygium projecting slightly posteriorly; ventral spine very short, heavy, and blunt. LEGS: Yellow brown to rufous, the coxæ and sometimes trochanters black; hairy, hairs densest and longest on the tarsi and on the hind tibiæ; claws prominently toothed. WINGS: Hyaline, tinged with yellowish, covered with fine, brown hairs, edges ciliate; veins brown, heavy, cross veins heaviest; areolet very large.

sometimes spectacularly so; cubitus usually not reaching the basalis, the tip curved downward toward a point below the mid-point of the basalis; radial cell closed; first abscissa of the radius arcuate-angulate, heavily but limitedly infuscated, usually without much of a projection. LENGTH: 3.7-4.7 mm.

GALL.—Elongate stem swelling. Polythalamous. Large, elongate, oval to spindle-shaped, averaging 25. mm. wide by 50. mm. long; large specimens scarcely greater in diameter will reach 110. mm. in length; covered with bark of natural color. Internally hard and woody, only the peripheral tissue being less compact than the normal stem wood; larval cells toward the center of the gall, oval, 3. by 5. mm., tissue almost not at all distinct from the rest of the wood; exit holes upon aging show a distinct, smoother area on the bark. On smaller stems of *Quercus chrysolepis*.

RANGE.—California: San Jacinto Mountains to Auburn and Ukiah. Probably wherever *Quercus chrysolepis* occurs.

This species was published very recently. The manuscript had been prepared a year previously, and at the time I did not recognize the several varieties represented by my material. In presenting these varieties it seems desirable to republish the specific description in order that it may be more available for comparisons. At the same time some corrections have been introduced, notably the consideration of the radial cell as closed, and of the second segment of the abdomen as short, with the third segment fully as long as the second, instead of taking the second to be long with a more or less definite division.

The variation shown by the species is not great, and is so confused by an unusual amount of individual variation that it has been difficult to define varietal differences. I have not yet been able to separate the San Bernardino material as the distinct thing we might expect it to be. This may be due to the fact that I collected all of my material of this species at the lower elevations in the San Bernardinos, instead of at the higher elevations which have given the more characteristic things from this range. It is interesting to find the Ukiah material belonging to the best defined variety. The galls of all varieties are much alike.

The wing venation in many individuals of this species shows the most unusual abnormalities I have ever seen in Cynipidæ. Specimens show the first abscissa of the radius out of line with the second intercubitus; or a vein between the second abscissa of the radius and the cubitus parallels the second intercubitus, or joins the second intercubitus; in sev-



eral a cross vein arises from the cubitus midway between the areolet and the basalis; the areolet may be closed; and other abnormalities occur. These should in all cases be preserved for a study on the homologies of cynipid venation.

### ***Andricus spectabilis* variety *spectabilis* (Kinsey)**

*Andricus spectabilis* Kinsey, 1922, Bull. Amer. Mus. Nat. Hist., XLVI, p. 289, figs. 11, 12.

FEMALE.—Differs from other varieties of the species as follows: Parapsidal and median grooves not especially broadened at the scutellum; median groove usually longer than in *ukiahensis*; anterior parallel lines prominent, distinctly broad; basal foveæ of the scutellum in part smooth, only moderately and in part rugose; mesopleuræ wholly but very finely coriaceous, in no place wholly smooth, less finely coriaceous, but still coriaceous centrally.

GALL.—Does not differ from the galls of the other varieties.

RANGE.—California: San Jacinto Mountains, San Bernardino(?), Upland, Pasadena, El Portal. Probably thruout the southern Sierras and their extensions.

TYPES.—76 females, 19 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, the Berlin Museum, and with the author. Labelled Pasadena, California; February 7, 1920; Kinsey collector.

On March 26, 1920, galls at El Portal contained large larvæ and mature adults, and showed some adults to have emerged previously. The majority of the adults had emerged from these galls by April 3. Emergence is probably earlier at more southern points.

### ***Andricus spectabilis* variety *incisus*, new variety**

FEMALE.—Differs from the females of other varieties as follows: Parapsidal grooves and median groove distinctly broader at the scutellum than in variety *spectabilis*; median groove moderately long; anterior parallel lines almost but not as wide as in variety *spectabilis*; foveæ about as smooth as in *spectabilis*; mesopleuræ almost wholly smooth beneath the tegulæ, very coarsely coriaceous in other places, not especially coriaceous-aciculate centrally as in *ukiahensis*; areolet large but averaging distinctly smaller than in other varieties; first abscissa of the radius heavy, but not as heavy as in other varieties.

GALL.—Does not differ from galls of other varieties.

RANGE.—California: Placerville, Auburn. Probably confined to the central Sierras from El Portal north.

TYPES.—8 females, 22 galls. Holotype female, paratype galls at The American Museum of Natural History; paratype females and galls



at Stanford University, the U.S. National Museum, and with the author. Labelled Placerville, California; March 30, 1920; Kinsey collector.

Adults were emerging from these galls at Placerville on March 30, 1920.

***Andricus spectabilis* variety *ukiahensis*, new variety**

**FEMALE.**—Differs from the females of other varieties of the species as follows: Parapsidal and median grooves not especially broadened at the scutellum; median groove distinct, but usually shorter than in variety *spectabilis*; anterior parallel lines very fine, basal foveæ of the scutellum very largely rugose, more so than in variety *spectabilis*; mesopleuræ entirely smooth beneath the tegulæ, coarsely coriaceous, even somewhat aciculate centrally.

**GALL.**—Does not differ from the galls of the other varieties.

**RANGE.**—California: Ukiah. Probably confined to a small region of the north Coast Range country.

**TYPES.**—13 females, 8 galls. Holotype female, paratype galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, and with the author. Labelled Ukiah, California; March 17, 1920; Kinsey collector.

The insects did not emerge until some time after collecting at Ukiah on March 17, 1920.

The very distinct nature of the anterior parallel lines would separate this variety even if other characters were lacking.

***Compsodryoxenus brunneus* Ashmead**

**FEMALE.**—Head wider than thorax; antennæ with 13 segments; mesonotum rather transversely rugose. **HEAD:** Wider than the thorax, distinctly enlarged behind the eyes; brownish rufous, finely coriaceous, finely rugose toward the mouth, naked except near the mouth. Antennæ brown, the first four or five segments golden yellow; with 13 segments, the second short but more elongate than globose, the third not much longer than the fourth, the last half again as long as the preceding. **THORAX:** Wholly brownish rufous, darker on the scutellum and on the sides; mesonotum finely rugose, rather transversely so, naked; parapsidal grooves fine, shallow, lost in rugose areas before reaching the pronotum; median groove lacking; anterior parallel lines very fine; not prominent; lateral lines fine, shallow; scutellum decidedly longer than wide, well rounded posteriorly, wholly, rather finely rugose, with two shallow depressions anteriorly indicating small, shallow, rugose foveæ; pronotum roughened laterally, hardly rugose; mesopleuræ mostly coriaceous, suggesting an aciculation in places, smooth on the posterior and ventral margins. **ABDOMEN:** Brownish rufous, lighter basally, much darker posteriorly especially dorsally; entirely smooth and naked; not longer than high, protruding somewhat ventrally, the hypopygium well developed, plow-shaped, the spine not long, fine, and slender; ventral

valves approaching the vertical; second segment covering not more than half the total area; edges of segments not very oblique, but well rounded ventrally. LEGS: Yellow to brown black, tips of tarsi darker; tarsal claws fine, simple. WINGS: Clear, not ciliate on the anterior margins, cross veins and subcosta rich brown, other veins fine; areolet of moderate size; cubitus not reaching the basalis; radial cell open, fairly wide, the second abscissa of the radius somewhat curved; first abscissa slightly angulate, without a projection; a brown cloud about the base of the radial cell, and between the areolet, the basalis, and the discoideus. LENGTH: 1.7-3.0 mm., averaging nearer 2.0 mm.

GALL.—None, or only a very slight swelling of the stem. The larval cells are elongate, averaging 2.5 mm. long by hardly 1.0 mm. wide, embedded in the wood, with the lining hardly distinct, and not at all separable. Mostly on young twigs of white oaks.

RANGE.—California.

The adults of the two varieties differ mainly in color, but the differences are so marked and constant in series of the two that there can be no question of their distinct nature.

These differences are correlated with the distribution of each variety in two faunal areas and on two different hosts. Both occur at much the same latitude; the two type localities are only about twelve miles apart, but at elevations differing by about thirty-five hundred feet. *Quercus chrysolepis*, the host of variety *brunneus*, belongs to a northern Sierran zone, which is limited to higher elevations. *Q. lobata*, the host of variety *atrior*, is confined to the Californian zone, which is always at a lower elevation. When I first discovered the distinct varieties, some time ago, I was ready to credit the differences in the two to their different hosts. Since then I have found some evidence that host differences are not always important unless two distinct faunal areas are involved. In this case it appears reasonable to ascribe the differences in the varieties primarily or in part to the same distributional factors which have delimited the parallel distributions of the hosts. Where geologic, geographic, and host isolation mark out the same bounds, very distinct forms may well be developed.

### ***Compsodryoxenus brunneus* variety *brunneus* (Ashmead)**

*Compsodryoxenus brunneus* Ashmead, 1896, Proc. U.S. Nat. Mus., XIX, p. 129. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 78; 1910, Das Tierreich, XXIV, p. 704. Beutenmuller, 1909, Bull. Amer. Mus. Nat. Hist., XXVI, p. 281. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 376. Thompson, 1915, Amer. Ins. Galls, pp. 10,

37. Felt, 1918, N.Y. Mus. Bull., 200, p. 71 (in part). Weld, 1921, Proc. U.S. Nat. Mus., LIX, p. 234.

The gall described and figured in these references is not the gall of this species.

FEMALE.—Differs from the female of the other variety as follows: Head lighter brownish rufous; thorax bright brownish rufous, slightly darker on the scutellum and the sides; anterior parallel lines very fine, not prominent but distinct; abdomen brownish rufous, brown black posteriorly; legs brownish yellow, the middle and the hind tibiæ darker brown; shading on wings moderately heavy, largely confined closely to the veins.

GALL.—None, or a slight stem swelling; the larval cells embedded in the wood, quite as in the other variety. On *Quercus chrysolepis*.

RANGE.—California: Mt. Diablo (Ashmead); Placerville. Probably confined to more northerly localities where *Q. chrysolepis* occurs.

TYPES.—Females and galls at the U. S. National Museum; labelled number 3085. From California, probably Mt. Diablo, rather than Martinez, for *chrysolepis* is not likely to be found at Martinez.

The redescription of the insect is made from adults collected at Placerville. I am not certain that Mt. Diablo and Placerville belong to one faunal area, but I do not now perceive differences between Ashmead types and my Placerville material.

In the original description Ashmead stated that "The gall of this species was likewise confused in the collection with a similar gall (*Andricus chrysolepidis*), occurring on *Q. chrysolepis* in California, but I can distinguish two kinds of galls, although both bear the same number (2972). Both are very much alike externally, but one is polythalamous, the other monothalamous, and I believe the latter is the one producing the present gallfly." He then records having received galls from Mount Diablo and Martinez, but does not state which he thought gave the *Compsodryoxenus*, or whether both lots appeared to be involved. I have seen a paratype gall, and find it a globular, woody, monothalamous gall entirely unlike the gall of any of the six other forms now known from this genus. Its monothalamous nature especially rules it out of this genus. I have cut adults of both varieties of the species from cells buried in twigs which showed little if any deformation, and have obtained a goodly number of insects from such cells collected at two separated localities. Undoubtedly Ashmead's insects came from cells hidden in the twigs of stems which bore galls of some other species.



Adults emerged from the Placerville material at some date after March 30, 1920.

**Compsodryoxenus brunneus variety atrior, new variety**

FEMALE.—Differs from the female of the other variety as follows: Head darker brownish rufous; thorax dark brownish rufous, very dark laterally; anterior parallel lines very fine, in part not evident; abdomen dark brownish rufous basally, largely very dark brown black; legs almost wholly brown, front legs lighter, all tarsi yellow brown, middle and hind tibiæ very dark brown black; shading on wings darker brown, much more extensive, extending well beyond the veins.

GALL.—None, or a slight swelling; the larval cells embedded in the wood; quite as in the other variety. On *Quercus lobata*.

RANGE.—California: Byron. Probably occurs thruout the range of *Quercus lobata* (and not improbably *Q. Douglasii*).

TYPES.—23 females, 2 infested stems. Holotype females, paratype females, at The American Museum of Natural History; paratype females and galls with the author; paratype females at Stanford University, the Museum of Comparative Zoology, the Philadelphia Academy, and the U.S. National Museum. Labelled Byron, California; March 19, 1920; *Q. lobata*; Kinsey collector.

The adults emerged at some time after collecting near Byron on March 19, 1920. The infestation is not to be discovered except by widespread, haphazard cutting into young twigs.

**Compsodryoxenus pattersoni, new species**

FEMALE.—Head and thorax yellow rufous, abdomen largely black; antennæ with 13 segments; thorax shagreened, rugose on the scutellum; parapsidal grooves not continuous to the pronotum; length about 1.5 mm. HEAD: As wide or wider than the thorax, distinctly widened behind the eyes; yellow rufous, the tips of the mandibles darker; finely rugosopunctate to coriaceous on the front, finely rugose on the lower part of the face, practically naked of hairs. Antennæ brownish black, the first four or five segments yellow rufous; pubescent; with 13 segments, the third segment hardly at all longer than the fourth, the last almost twice as long as the preceding. THORAX: Mostly bright yellow or brownish rufous; mesonotum regularly shagreened, practically naked of hairs; parapsidal grooves distinct posteriorly, less so anteriorly, hardly reaching the pronotum, not diverging greatly anteriorly; median groove absent; anterior parallel lines barely indicated for half the mesonotal length; lateral lines fine, but distinct, smooth, diverging posteriorly; scutellum darker rufous, sometimes almost black on the edges, rather finely but deeply rugose, naked of hairs, with two foveæ indicated in the longitudinally furrowed depression at the base; pronotum rufous, rough and shagreened at the sides; mesopleuræ darker rufous to black, roughly shagreened, with some shallow, irregular furrows. ABDOMEN: Black, rufo-piceous ventrally and on the hypopygium; entirely naked of hairs:



closely and distinctly punctate; not produced dorsally, the second segment not covering one-third the abdomen, its edge only slightly oblique. LEGS: Brownish, the tarsi yellowish with dark tips, the middle tibiae and the hind tibiae and femora almost black; hairy; tarsal claws weak, simple. WINGS: Very clear, set with only minute hairs; edges only very short ciliate; veins brownish black, cross veins heaviest; areolet of moderate size or smaller; cubitus fine, reaching only half way to the basalis; radial cell moderately short, open, the second abscissa of the radius somewhat curved; the first abscissa arcuate, deeply and widely infuscated; with a light brown cloud extending over the areolet and a similarly colored, large spot below the areolet. LENGTH: 1.5-1.7 mm.

GALL.—A slight but distinct swelling of small roots. Polythalamous. Galls gradual enlargements from the stems, elongate, averaging 20. mm. long by 4. mm. wide, often larger, covered with natural or slightly roughened bark. Internally woody, but the tissue irregular, with the larval cells closely clustered, the lining not separable nor hardly distinct, each cell spherical, about 1.0 mm. in diameter. On roots of *Quercus virginiana*.

RANGE.—Texas: Austin (Patterson).

TYPES.—149 females and 4 galls. Holotype female, paratype females, and gall in The American Museum of Natural History; paratype females and galls in the U.S. National Museum and with the author; paratype females at the Museum of Comparative Zoology, the Philadelphia Academy, and Stanford University. Labelled Austin, Texas; *Q. virginiana*; Patterson collection numbers 18a and 18b.

One of the galls is constricted into two parts, the parts bent at an angle; the other galls are straight, undivided; the two types of galls give the same kinds of adults. These galls contained live adults in December; insects emerged on February 9. It is not impossible that adults are mature in the galls over the winter, not emerging until early in the following spring. Similar but much smaller swellings at the bases of the petioles (Patterson collection number 155) had adults emerge on Dec. 27 which appear exactly identical with those from the root galls. Some sort of alternation of generations may be involved here, but it is not unlikely that the species will produce galls on various parts of the plant, not being confined to the roots only.

### *Cynips mirabilis*, new species

*Holcaspis maculipennis* Beutenmuller (in part), 1909, Bull. Amer. Mus. Nat. Hist., XXVI, p. 43, pl. IX, figs. 2, 3.

*Cynips maculipennis* Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 344. Felt (in part), 1918, N.Y. Mus. Bull., 200, p. 100, fig. 63 (2, 3).

*Amphibolips quercus-inanis* Trotter (error), 1910, Boll. Lab. Portici, V, p. 101.

(Not (!) *Holcaspis maculipennis* Gillette, 1894, Can. Ent., XXVI, p. 236.)

**FEMALE.**—Median groove evident in part; parapsidal grooves continuous; abdomen hairy on the sides of all the segments; almost a score of spots in the cubital cell; length about 4.5 mm. **HEAD:** Not as broad as the thorax, considerably widened behind the eyes; brownish rufous, darker on the median elevation and piceous on the mandibles; finely rugose, mostly hairy, dense with long, yellowish hairs on the face, naked on the front. Antennæ deep brown, tinged with rufous on the first two segments; hairy; with 14 segments, the first segment almost as long as the fourth, the second segment globose, the third considerably longer than the fourth, the last distinctly longer than the preceding. **THORAX:** Bright rufous, black between the parapsides except posteriorly, and black about the lateral lines; mesonotum smooth, finely punctate, not heavily covered with long, yellow hairs; parapsidal grooves continuous, distinct to the pronotum, rather well convergent posteriorly, only gradually divergent anteriorly; median groove discernible for almost half the length of the mesonotum, quite distinct posteriorly; anterior parallel lines fine but evident, most distinct and smooth and divergent posteriorly, extending half way to the scutellum; lateral lines very prominent, broad, elevated, smooth, and naked; scutellum wide, but considerably longer than wide, rounded posteriorly, rich rufous, finely rugose, sparsely hairy, dense with yellow hairs at the sides, with a slight indication of a longitudinal, median depression as in the genus *Amphibolips*; basally with two very large foveæ, black, shining, deeply grooved, indistinctly separated by irregular ridges; pronotum at the sides rich rufous, smooth, finely punctate, sparsely hairy; mesopleuræ rufous with some black, punctate, hairy, densely so ventrally. **ABDOMEN:** Longer than wide, the segments only slightly produced dorsally, rufous to rufo-piceous and black, darkest dorsally and ventrally, practically smooth tho very microscopically punctate, more distinctly punctate where hairy, a heavy coating of yellowish hairs on the sides of all the segments, a tuft of long, yellow hairs on the tip of the ventral spine. **LEGS:** Femora rufous, coxæ yellow rufous, tarsi and tibiæ rufous brown; punctate, dense with yellow hairs, hairs only sparse on the femora; tarsal claws heavy, toothed. **WINGS:** Tinged with yellow, veins yellowish brown, cross-veins darker; areolet large; radial cell open, the second abscissa of the radius not reaching the margin, curved, thickened, and peculiarly knobbed terminally; the first abscissa sharply angulate but without a projection, infuscated, as is also the subcosta terminally; light brown clouds in the cubital and discoideal cells, about a score of distinct, brown spots in the cubital cell. **LENGTH:** 4.5-5.0 mm.

**GALL.**—Globular leaf gall; monothalamous; 15-35. mm. in diameter, thin-shelled, smooth, yellowish brown, rather closely marked with irregular, purplish brown spots. Internally with a hard-shelled larval cell, 3. x 5. mm., held centrally by a moderately dense mass of silky, sparingly branched fibers. On leaves of *Quercus garryana*.

**RANGE.**—Washington: White Salmon. Oregon: Ashland, Junction City, Grants Pass, Roseburg, Canby; Portland (E. O. Hovey); Albany (Trotter). California: Ukiah(?), Yreka; McConaughy, Siskiyou Co. (Fullaway); Elsie Creek, Amador Co. (G. Hansen, in Gray

Herb.). Probably found thruout northern California, Oregon, Washington, and British Columbia, wherever *Q. garryana* occurs.

TYPES.—5 females, 10 galls. Holotype female, paratype females, and galls in The American Museum of Natural History; paratype females and galls with the author. Labelled Portland, Oregon; October, 1905; E. O. Hovey collector.

By a mistake in identification of this Hovey material, this species has gone thru the literature as Gillette's *maculipennis*. The two are generically related, but are very distinct species. *Maculipennis* was described from New Mexico, and is restricted as far as I know to a southern Rocky Mountain area; *mirabilis* is confined to the Vancouverian zone of the Pacific Coast, at present recorded only from *Quercus garryana*, or some of its varieties, on which oak it is very abundant. Apparently adults emerge late in the fall or early in the spring, for by early March the galls are all vacated. This species belongs to *Cynips* Hartig; and not to *Cynips* of most American authors; the species shows also some characteristics of *Amphibolips*, with which genus the physiology reflected by gall characters would connect the insect.

### ***Diastrophus kincaidii* Gillette**

FEMALE.—Wholly black except on legs and mouthparts; median groove short; foveæ not sharply defined; first abscissa of the radius almost straight. HEAD: Broader than the thorax, somewhat enlarged behind the eyes; black, mouthparts yellow to rufo-piceous; vertex smooth and naked, a few scattered hairs behind the eyes, face puncto-rugose, hairy; rugose, radiating striations from the mouth to the eyes. Antennæ brownish black to black, browner basally; pubescent; with 13 segments, the second not quite globose, the third half again as long as the fourth, the last almost twice the length of the preceding. THORAX: Entirely black; mesonotum smooth, shining, and naked; parapsidal grooves rather fine but distinct, continuous to the pronotum where they are widely divergent, gradually and closely convergent at the scutellum; median groove distinct in some irregular sculpturing between the parapsides at the scutellum, usually short, sometimes discernible for a third or more of the mesonotal length; anterior parallel and lateral lines practically absent, barely indicated sometimes; scutellum elongate, narrow, rather finely rugose, depressed anteriorly, the depression divided by a rugose, raised area into smaller or larger foveæ; pronotum moderately broad dorsally, puncto-rugose and scatteringly hairy; mesopleuræ mostly smooth and naked, finely rugose dorsally, finely aciculate centrally and scatteringly elsewhere. ABDOMEN: Black, piceous basally and ventro-posteriorly, entirely naked and smooth, extending ventrally as far as or farther than dorsally, segments produced somewhat dorsally, edges oblique and very much rounded ventrally; second segment small,



not covering a quarter of the abdomen; ventral spine practically lacking. LEGS: Wholly bright rufous brown even on the coxæ, hairy; tarsal claws fine, weak, toothed. WINGS: Clear; hardly ciliate on the anterior margins; veins rich brown, rather heavy; areolet usually present; cubitus reaches the basalis at the midpoint; radial cell rather short and broad, open, the second abscissa of the radius hardly curved, failing considerably to reach the edge; first abscissa of the radius almost straight with hardly a suggestion of a curve; radial cell entirely clear, a brownish infuscation about the terminal part of the subcosta, extending into the subcostal cell. LENGTH: 1.5-2.5 mm.

MALE.—Differs from the female as follows: Antennæ with 14 segments; abdomen much smaller; areolet smaller, terminal part of subcosta practically without infuscation; length 1.2-1.8 mm.

GALL.—Large, irregular stem swelling. Polythalamous, with a great many cells. Swelling rather abrupt, elongate, up to 60. mm. in length by 20. mm. in diameter; somewhat irregular, smoothed, covered with bark of normal color. Internally filled with mostly loose tissue in which the larval cells are densely crowded, the cells not separate, but almost separable, broadly oval, averaging 2. x 2.5 mm. On stems of *Rubus parviflorus* (acc. B. G. Thompson in Mus. Comp. Zool.), and *R. nutkanus*.

RANGE.—From Alameda Co., California, to Washington and Idaho.

These two varieties are about as similar as any two forms which I should call distinct. Both insects and galls share the similarity. The best single distinction between the insects is the nature of the foveæ of the scutellum; other characters are distinct mostly in their averages. The two have distinct ranges. This species is not so very different from *Diastrophus nebulosus* and *D. turgidus* of the eastern parts of the United States, and I am not entirely certain that all of these should not be considered varieties of one species.

### **Diastrophus kincaidii** variety **kincaidii** (Gillette)

*Diastrophus kincaidii* Gillette, 1893, Can. Ent., XXV, p. 110. Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 662, 841. Thompson, 1915, Amer. Ins. Galls, pp. 24, 44.

*Diastrophus Kincaidi* Kieffer, 1902, Bull. Soc. Metz, X, p. 92. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 73.

*Diastrophus kincaidi* Beutenmuller, 1909, Bull. Amer. Mus. Nat. Hist., XXVI, p. 138, pl. XXVII, figs. 2, 3. Felt, 1918, N.Y. Mus. Bull., 200, p. 142, fig. 141 (2, 3). Kinsey, 1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 371.

FEMALE.—Differs from the female of the other variety as follows: Antennæ rather short and thickened, somewhat thicker apically; anterior parallel and lateral lines only indicated, but perhaps less distinctly than in *austrior*; scutellum with foveæ indefinite, mostly rugose



at bottom, with small, smoother areas laterally; areolet of moderate size to very small or closed; radial cell entirely clear, a limited, brown infuscation about the terminal part of the subcosta extending into the subcostal cell only.

MALE.—Differs from the male of *austrior* in having the areolet small or very small, averaging smaller.

GALL.—Quite similar to that of *austrior*.

RANGE.—Washington: Seattle (in Amer. Mus. Nat. Hist.); Olympia (Gillette); White Salmon. Oregon: Corvallis (B. G. Thompson in Mus. Comp. Zool.). Idaho: Cedar Mts. (Beutenmuller det.).

TYPES.—C. P. Gillette collection?.

I have not seen the Idaho material. The B. G. Thompson material in the Museum of Comparative Zoology was bred January 24 and 27. Gillette bred his adults in March. Material which I collected at White Salmon, Washington, April 11, had most of the adults already emerged, tho a few emerged after that date. I am inclined to believe late March is the average time of emergence. Of 64 adults of which I have record, 21 are males. I have collected galls which were widely broken into, possibly by birds, more probably by mice in search of the ready mess of larvæ or pupæ.

### ***Diastrophus kincaidii* variety *austrior* new variety**

*Diastrophus kincaidi* Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 375.

FEMALE.—Differs from the other variety as follows: Antennæ distinctly slender, not as short as in the other variety; anterior parallel and lateral lines only indicated but perhaps more distinctly than in variety *kincaidii*; scutellum with two very distinct, good-sized foveæ which are smooth at bottom; areolet of moderate size to large, rarely small; radial cell mostly clear, a light brown infuscation about the terminal part of the subcosta more often extending equally into both radial and subcostal cells.

MALE.—Differs from the male of variety *kincaidii* in having the areolet of moderate size or small, averaging larger.

GALL.—Quite similar to that of variety *kincaidii*.

RANGE.—California: Point Arena (Fullaway); Alameda Co. (thru Riley); Mt. Tamalpais.

TYPES.—32 females, 13 males, 26 galls. Holotype female, paratype adults, and galls in The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, and with the author. Labelled Mount Tamalpais, California; March 14, 1920; Kinsey collector.

Some of the insects had emerged before March 14, but all of the types emerged after that date.

**Diplolepis bassetti** (Beutenmuller)

**FEMALE.**—Mostly black, legs largely rufous; parapsidal grooves very distinct, continuous; mesonotum distinctly coriaceous, punctate, and hairy; scutellum without foveæ; radial and part of cubital cells smoky. **HEAD:** About as broad as or somewhat broader than the thorax; black, mandibles dark rufous, piceous on the tips; front coriaceous, smooth in part, naked; face puncto-rugose, hairy. Antennæ almost wholly black, sometimes the two basal segments tinged piceous; finely pubescent; with 14 segments, the second globose, the third almost twice the length of the fourth, the last almost twice the length of the preceding, an incomplete division indicated. **THORAX:** Wholly black; mesonotum shining, smoothed, coriaceous in places, especially between the parapsides posteriorly, scatteringly punctate and hairy; parapsidal grooves very distinct, continuous to the pronotum, tho obscured in sculpturing anteriorly, only gradually divergent anteriorly, gradually but not very closely convergent posteriorly; median groove distinct at the scutellum, indicated a third of the mesonotal length; anterior parallel lines fine and faint, indicated more than half the mesonotal length; lateral lines practically absent; pronotum laterally rugose; mesopleuræ rugose dorsally, mostly smooth and shining, crossed by a moderately broad, rugose, horizontal line; scutellum quite elongate, well rounded posteriorly, closely rugose, depressed anteriorly only laterally, without foveæ, a broad, elevated ridge extending from the mid-point of the scutellum to the mesonotum. **ABDOMEN:** Entirely black, entirely smooth, shining, naked; distinctly elongate, more than half again as long as high, segments produced somewhat dorsally, only moderately rounded ventrally, the second segment covering only about one third of the total area; ventral sheath produced, plow-shaped, the spine short. **LEGS:** Brownish rufous with more or less piceous, tarsi less bright, the tips dark; covered with hairs; tarsal claws weak, simple. **WINGS:** Finely ciliate on the margins, yellowish, entirely smoky, most so in the radial cell and nearby in the cubital cell; veins heavy, dark brown; areolet distinct; cubitus becoming fine, but reaching the basalis below the midpoint; radial cell open (!), tho somewhat darkened on the margin, very short and broad; second abscissa of radius not greatly curved; first abscissa of the radius angulate at about 75°, with a short but very distinct projection. **LENGTH:** 2.0-3.2 mm.

**MALE.**—Differs from the female as follows: Eyes protruding as far as or farther than the cheeks; mandibles brighter in color; antennæ with 15 segments; the abdomen small and slender; the wings less smoky; areolet somewhat smaller, radial cell somewhat less open; length 1.7-2.7 mm.

**GALL.**—Mossy, containing a compact or agglomerated cluster of woody cells. Filamentous covering 4.0-8.0 mm. thick, probably green and reddish when young, becoming brown and blackened with age: filaments attached to a more or less compacted cluster of larval cells, each cell sub-spherical, 2.0-4.0 mm. in diameter, with woody but not thick walls, entirely hollow within. On the twigs, usually terminally, of *Rosa nutkana*.

RANGE.—Oregon, Idaho, and Utah. Probably elsewhere in the northwest.

Morphologically the insects of this species are decidedly related to *Diplolepis rosæ*, and less closely to *D. bicolor*. Significantly, the galls of variety *bassetti* show striking similarity to those of *rosæ*. The galls of the other variety, tho superficially similar to *rosæ*, are in all respects merely a compact cluster of galls of the *D. bicolor* type, differing mainly in possessing the filamentous covering. The evolutionary transition from the galls *bicolor* to *rosæ*, or the reverse procedure, cannot have been more profound than the evolution of the two types of galls in this one species.

There will be no question that this is a single species, for the characters separating the two varieties are very few. But if one has any doubt of the validity of the varieties he should examine a large series of individuals, when he should be impressed with the constancy of the distinctions within these few characters. Geographic isolation has probably contributed materially to the separation of two forms, for as far as the ranges of the two are known at present they are separated by the high altitudes of the barren lava-bed country of western Oregon. The type localities of the two are two hundred and fifty miles apart. Moreover, variety *bassetti* occurs in a region of excessive precipitation and tempered seasons, while the other variety occurs in the very arid deserts of the northern Rocky Mountains, a country of extreme climate.

I should not consider this a variety of *Diplolepis rosæ*, tho the two are very close. *Rosæ* seems to be a native of Europe, but has more or less of a world-wide distribution, being readily imported into new regions; and apparently the species reached the eastern part of the United States as an importation from Europe. *Rosæ* has not been recorded from west of the Rockies. No species native to America is very closely related to *rosæ* except this Pacific Coast species, *bassetti*. There may be considerable significance in this situation.

***Diplolepis bassetti* variety *bassetti* (Beutenmuller)**

*Rhodites bassetti* Beutenmuller, 1918, Can. Ent., L, p. 307, pl. IX, figs. 13, 14.

FEMALE.—Differs from the female of the other variety as follows: Eyes not protruding beyond cheeks; scutellum closely rugose,

uniformly so even on the elevated central portion and on the elevated ridge to the mesonotum; legs mostly bright brownish rufous, coxæ touched with piceous; areolet of moderate size.

MALE.—Differs from the male of the other variety as follows: Mandibles dark rufous brown; legs mostly bright rufous, with the tarsi darker and the coxæ wholly piceous; wings distinctly smoky in the radial cell but less so than in the female; areolet small.

GALL.—Superficially resembles the gall of the other variety, but is distinct as follows: Filaments finer, more dense and curled; often a hundred or more larval cells in a cluster, the cells thoroly fused together, forming a perfectly solid, woody mass; galls averaging large, often up to 45. mm. in diameter.

RANGE.—Oregon: Corvallis (Beutenmuller); Ashland.

TYPES.—In the Beutenmuller collection(?), and at the Museum of Comparative Zoology. From Corvallis, Oregon; B. G. Thompson, collector.

The above descriptions were made from material I collected at Ashland. Of 85 adults, 39 are males. Beutenmuller states that galls collected in December gave adults from late February to the middle of March, indoors. Most of the adults had not yet emerged from the galls collected at Ashland on April 6.

### ***Diplolepis bassetti* variety *lucida*, new variety**

FEMALE.—Differs from the female of the other variety as follows: Eyes distinctly protruding beyond the cheeks; scutellum closely rugose, only finely rugose and distinctly shining on the elevated central portion and on the elevated ridge to the mesonotum; legs bright brownish rufous, the coxæ, trochanters, and a small part of the femora piceous; areolet very large.

MALE.—Differs from the male of the other variety as follows: Mandibles light yellow rufous; the scutellum almost without the smoother area of the female of this variety; the legs generally darker, the coxæ, trochanters, and a large part of the femora piceous; wings almost clear, almost entirely clear in the radial cell; areolet large but not as large as in the female of this variety.

GALL.—Superficially resembles the gall of the other variety, but is distinct as follows: Filaments heavier, broader, straighter; usually only 30 or fewer larval cells in a cluster, each cell more or less entirely separate, with a proximate origin from the stem, the cells compacted into an insecure mass more by the intertwining filaments than by a fusion of the wood of each cell; the whole mass averaging smaller than in the other variety, 25. mm. the maximum diameter noted.

RANGE.—Oregon: La Grande. Idaho: Mountain Home.

TYPES.—115 females, 83 males, 36 galls. Holotype female, paratype adults, and galls in The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy,



and with the author. Labelled La Grande, Oregon; April 12, 1920; Kinsey collector.

Few of the adults had emerged on April 12 at La Grande, and on April 20 at Mountain Home. Of 267 adults, 100 are males.

The collection at Mountain Home, Idaho, has peculiar interest because that locality is in the heart of the Snake River desert. This is an alkaline, dust desert, barren of most vegetation except sage brush, with an excessively low precipitation; because of its elevation of about 3500 feet, and its great, level sweep, the region is exposed to severe storms and extreme temperatures in winter, and to a surprisingly hot summer. Repeated searchings at several localities across this desert failed to disclose any plant which might bear *Cynipidæ*. The oaks, mainly eastern species, planted as wind breaks in the towns, failed to disclose galls. Some distance outside of the town of Mountain Home, a few roses were growing beside an irrigation ditch, and there were two galls of this species and variety. I do not know whether the roses were native species or escapes from cultivation; they bore a native cynipid. How far it may have been to the next colony of roses it would be hard to determine; I am inclined to believe it might have been a considerable distance. Insects and galls of this material agree in minute detail with material from La Grande, two hundred miles away, mostly across the desert. The desert does possess a system of streams, but roses are few at most along these streams, for I failed to find them at any of a half dozen other points at which I tried to collect.

I collected galls of this type at Brigham, Utah, but did not obtain insects, so I cannot say whether yet another variety will be found for this species.

### **Diplolepis fusiformans (Ashmead)**

FEMALE.—Head and thorax black, abdomen in part rufous; mesonotal grooves and lines shallow or obscure; mesopleuræ smooth, crossed by a wide, rugose band; abdomen entirely smooth; areolet small. HEAD: Wider than the thorax, not enlarged behind the eyes; black, the mouthparts colored lighter; finely coriaceous, more coarsely so on the face; vertex naked, face hairy. Antennæ slender, black, the first two segments colored lighter; with 14 segments, the second globose, the third at least half again as long as the fourth, the last somewhat longer than the preceding. THORAX: Wholly black; mesonotum irregularly, rather finely coriaceous or shagreened, punctate, finely hairy; parap-

sidal grooves rather fine and shallow, continuous to the pronotum, slightly obscured in a more rugose area anteriorly; median groove indicated for a quarter the length of the mesonotum; anterior parallel lines barely indicated; lateral lines more or less distinct; scutellum elongate, well rounded posteriorly, rugose, depressed anteriorly, most so laterally, not forming distinct foveæ; pronotum laterally rugose; mesopleuræ smooth, only obscurely coriaceous, shining, naked, edges rugose, transversely crossed below the middle with a rugose band which is very rugose posteriorly. ABDOMEN: Brighter basally, darker posteriorly and ventrally; entirely smooth, naked except for a very few hairs basally; of moderate length, somewhat produced dorsally, the second segment covering a half to two-thirds or more of the area; edges of segments somewhat oblique; hypopygium broad, pointed, the spine short, fine. LEGS: In part rufous, in part brown; tarsal claws fine, simple. WINGS: Narrow; only finely ciliate on the margins; tinged yellowish especially on the radial cell; veins not heavy, of a medium brown; areolet small to closed; cubitus hardly continuous, faint at the basalis; radial cell closed but the marginal vein rather faint, of moderate length, the second abscissa of the radius only slightly curved; first abscissa well curved, arcuate with only a slight suggestion of an angle. LENGTH: 1.5-2.2 mm.

MALE.—Differs from the female as follows: First two segments of the antennæ darker, third segment relatively longer; abdomen piceous black, very small, somewhat pedicellate, sometimes elongate triangulate; legs darker; wings almost clear, the radial cell more distinctly closed; length 1.2-2.0 mm.

GALL.—Small, elongate stem swelling. Polythalamous, with rather few cells. Irregular, usually longer than wide, sometimes rather globose, more or less abrupt, usually but not always symmetrical about the stem, covered with brown bark somewhat different from the normal bark; up to 30. mm. long by 8. mm. in diameter, usually smaller, sometimes several more or less fused. Internally woody, rather solid, the normal stem tissue more evident centrally; the larval cells more or less elongate oval, the lining rather distinct but inseparable. On stems of *Rosa* species.

RANGE.—Canada: Toronto (Cosens). Illinois (Weld). Colorado. California. Probably occurs thruout North America, wherever roses occur.

This is one of the primitive species of the genus, as indicated by the closed radial cell, the small second abdominal segment, the equal numbers of the two sexes, and the slight development of the gall. It is not the same species as *Diplolepis verna* (Osten Sacken), altho both species are primitive. This species should be discovered wherever roses occur in North America, and many other varieties will need to be described.

Of 236 insects I have bred, only 89, or 38 per cent, are

males. But material of one variety gave over 50 per cent males, suggesting that the sexes are probably equal if the collections are adequate. The insects emerge in spring, from February further south to April (or later?) further north. It is unlikely that an alternation of generations occurs.

**Diplolepis fusiformans variety fusiformans (Ashmead)**

*Rhodites fusiformans* Ashmead, 1890, Bull. Colo. Biol. Assoc., I, pp. 14, 38. Cockerell, 1890, Ent., XXIII, p. 75; 1900, Ent. Student, I, p. 10. Gillette, 1892, Ent. News, III, p. 246. Dalla Torre, 1893, Cat. Hymen. Cynip., II, p. 127. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 78; 1910, Das Tierreich, XXIV, pp. 717, 840. Beutenmuller, 1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 643, pl. XLVI, figs. 10-12. Thompson, 1915, Amer. Ins. Galls, pp. 22, 45. Felt, 1918, N.Y. Mus. Bull., 200, p. 146, fig. 150 (10-12). Kinsey, 1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 393.

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Mouthparts yellow or brown rufous, the mandibles tipped piceous; first two segments of the antennæ bright rufous brown; lateral lines fine, smooth, distinct; abdomen bright yellow rufous, dark brownish rufous posteriorly and ventrally; second segment covering fully two-thirds or more of the abdomen; hypopygium relatively smaller than in *minuta*; legs almost entirely bright yellow rufous, coxæ somewhat darker basally, the hind tibiæ and tarsi brown; areolet moderately small; length 1.7-2.2 mm.

MALE.—Differs from the males of the other varieties as follows: Lateral lines somewhat smooth; second segment covering three-quarters of the abdomen; legs dark brown on the coxæ and femora and hind tibiæ; areolet moderately small; length 1.5-2.0 mm.

GALL.—Differs from the galls of other varieties in having the swelling rather abrupt, distinct, sometimes globose; up to 17. mm. in length and 8. mm. in diameter; usually with only six or eight larval cells.

RANGE.—Colorado: West Cliff, Colorado Springs (Cockerell); Manitou. Probably confined to an area in Colorado in the foothills on the eastern side of the Continental Divide.

TYPES.—Females, males, and galls at the U.S. National Museum. From West Cliff, Colorado; T. D. A. Cockerell collector.

The redescriptions are made from material I collected at Manitou on April 24, 1920; I have compared it with the Ashmead types.

Of 86 insects I bred from the galls collected at Manitou, 17, or only 20 per cent, are males. Probably the sexes are more nearly equal in number, some of the males having emerged before collection.

This insect has also been recorded from Illinois and

Toronto (Beutenmuller, 1914, Bull. Brooklyn Ent. Soc., IX, p. 88, pl. V, figs. 6-8); I have not seen this material, but feel certain it must represent at least distinct varieties, for the faunal area in which true *fusiformans* occurs is limited to a small part of Colorado.

**Diplolepis fusiformans variety minuta, new variety**

**FEMALE.**—Shows the following characters in addition to those common to all varieties of the species: Mouthparts dark rufous to black, darker than in *mendocinensis*; first two segments of the antennæ very dark brown, averaging darker than in *mendocinensis*; lateral lines not smooth, not very evident; abdomen dark brown rufous, almost black posteriorly and ventrally; second segment covering a half or somewhat more of the abdomen; hypopygium relatively larger than in *fusiformans*; legs yellow rufous, the coxæ basally, parts of femora, and the hind tibiæ dark brown; areolet very small or closed; length 1.0-1.5 mm.

**MALE.**—Differs from the males of other varieties as follows: Lateral lines not smooth, barely evident; second segment covering only about half of the abdomen; legs almost black on the coxæ and femora and the hind tibiæ; areolet almost closed; length 1.5 mm.

**GALL.**—Differs from the galls of other varieties in having the swelling only slightly larger than the stem, not over 20. mm. in length and 3.5 mm. in diameter, hardly noticeable except by the distorted bark; larval cells few, usually not over four in a gall.

**RANGE.**—California: San Bernardino Mountains (Little Bear Lake). Probably confined to the neighborhood of this range.

**TYPES.**—11 females, 2 males, 60 galls. Holotype female, paratype female, and galls at The American Museum of Natural History; paratype females and galls at Stanford University and the U.S. National Museum; paratype galls at the Museum of Comparative Zoology and the Philadelphia Academy; paratype females, males, and galls with the author. Labelled San Bernardino, California; January 31, 1920; Kinsey collector.

This is the smallest cynipid I know inhabiting roses. The insect is quite distinct from variety *fusiformans*, but closely resembles *mendocinensis*. It is reasonable that the two California varieties should be more closely related to each other than to the Colorado variety. The galls of the two California varieties also more closely resemble each other than they do the Colorado variety, but are very definitely different.

*Minuta* galls are almost unnoticeable, so little do they distort the stems. They are located usually toward the tips of the stems, and sometimes kill the stem beyond. Large larvæ were in the galls on January 31, 1920, and emerged at some later date.



**Diplolepis fusiformans** variety **mendocinensis**, new variety

**FEMALE.**—Shows the following characters in addition to those common to all varieties of the species: Mouthparts rich brownish rufous; first two segments of the antennæ medium rufo-piceous to very dark brown, sometimes lighter than in *minuta*; lateral lines not smooth, not very evident; abdomen dark brown rufous, dark brown posteriorly and ventrally, not as black as in *minuta*; second segment covering a half or somewhat more of the abdomen; hypopygium relatively larger than in *fusiformans*; legs yellow rufous, the coxæ basally, parts of the femora, and the hind tibiæ dark brown; areolet very small or closed; length 1.7-2.2 mm., averaging about as large as *fusiformans*.

**MALE.**—Almost identical with the male of *minuta*, the legs averaging lighter, especially not as dark on the coxæ and femora; the areolet more often of moderate size, larger than in the female; length 1.5-2.0 mm.

**GALL.**—Differs from the galls of other varieties in having the swelling of moderate size, up to 30. mm. in length and 5.0 mm. in diameter, sometimes with several galls fused together; the larval cells clustered, with sometimes about 30 in a gall.

**RANGE.**—California: Ukiah. Probably confined to a region in Mendocino and northern Sonoma counties.

**TYPES.**—67 females, 70 males, 80 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Ukiah, California; March 17, 1920; Kinsey collector.

On March 17, 1920, the galls at Ukiah contained mature larvæ, with evidence that some of the insects had already emerged. Of the 137 adults bred, 70, or just about 50 per cent, are males. The galls are usually located near the tips of the twigs, and altho they are only slight swellings of the stem are rather noticeable, because in many cases the bark covering of the cluster of cells is to some extent lost. Whether this is due to the weathering away of the thin bark, or to attacks of birds or mice I cannot determine.

The insect very closely resembles the insect of *minuta*, from which it is distinguished mainly by minor color differences and the very distinct size. This size difference is too great and too constant to be ignored. Moreover the galls of the two are distinct, altho they are more similar to each other than to *fusiformans*. This correlation of similarities between the morphological and physiological characters of the insect is worth attention.

**Diplolepis radicum** (Osten Sacken)

**FEMALE.**—Mesonotum rather smooth; parapsidal grooves lost in rugose areas anteriorly; scutellum without foveæ; abdomen wholly smooth; wings largely yellow. **HEAD:** Somewhat wider than the thorax, hardly enlarged behind the eyes; black, the mouthparts deep rufous, the tips of the mandibles piceous; finely granulose rugose and naked on the vertex and cheeks, roughly rugose and hairy on the face. Antennæ short, thick, hairy, black, the first two segments rufous to piceous; with 14 segments, the second segment about globose, the third twice the length of the fourth, the last not half again as long as the preceding. **THORAX:** Wholly black; mesonotum mostly smoother, shining, sparsely set with short hairs, especially anteriorly, and irregularly roughened, in part coriaceous, deeply rugose at the anterior ends of the parapsidal grooves; parapsidal grooves deep, rugose at bottom, almost continuous, lost in the rugose area anteriorly; median groove lacking, short, or discontinuous; anterior parallel lines fine or absent; lateral lines long, fine, and shallow, more or less distinct; scutellum much longer than wide, roundly pointed posteriorly, very rugose, depressed and more rugose anteriorly with a more or less elevated, slightly smoother area extending from the middle of the scutellum anteriorly to divide the anterior depression; pronotum laterally very rugose; mesopleuræ largely smooth and shining, the surface slightly uneven, rugose on the dorsal edge anteriorly, and crossed below the center by a deep, rugose, transverse band. **ABDOMEN:** Piceous black, more brownish or rufo-piceous basally; entirely smooth and shining, entirely naked except for a very few hairs basally; small, short, considerably produced dorsally, the second segment covering one-half to three-quarters of the area, the edges of the segments oblique, the hypopygium broad, pointed, the spine short. **LEGS:** Brownish rufous, the tarsi brighter, the coxæ darker basally; tarsal claws moderately heavy, simple. **WINGS:** Yellowish, especially about the radial cell; margins only short ciliate; veins rather fine, of a medium brown; the areolet of a moderate size or large; the cubitus very faint, short, not continuous; radial cell short, broad, open, the second abscissa of the radius sharply bent near the base; the first abscissa arcuate, only suggesting an angle. **LENGTH:** 3.0-4.0 mm.

**MALE.**—Differs from the female as follows: Third segment of the antenna slightly curved; median groove not distinct but discontinuously indicated for some distance; abdomen black, slender, elongate, the second segment covering hardly two-thirds of the area, edges of segments about vertical; yellow shading on wings not as heavy.

**GALL.**—A large, massive, pithy root gall. Polythalamous, larger galls with a hundred or more larval cells. Very irregular in shape, but generally rounded, globular, depressed at the points of attachment, irregularly folded, gnarled, sometimes as an unopened bud; variable in size, up to 105. mm. in length by 70. mm. in diameter; reddish brown, darkening with age. Internally soft, rather pithy, with only a small amount of woody fiber; the larval cells large, nearly round, often 4. mm. in diameter, with a smooth but hardly distinct, inseparable lining. On

stems and roots, under ground, or under debris close to the ground; sessil or nearly so, laterally or terminally, on roses.

RANGE.—Canada and Maine to North Carolina and Washington. Probably everywhere in North America where roses occur.

The insects emerge rather late in the spring, in April or May or later, depending on the development of the season. Immature galls may be found in July or August. The species is bisexual, with the sexes about equal in numbers, and probably takes only a single year to mature, without an alternation of generations. The number of parasites bred is not great, altho they do occur. W. M. Davis (1908) records finding galls broken into by mice.

Two varieties, *radicum* and *utahensis*, of this species have been previously described. They have been considered distinct species, the adults on the basis of trivial characters which cannot be counted more than varietal, and the galls on the basis of the original description of *utahensis*, which states that the gall is deeply incised like a bud, and that it does not occur entirely below the ground. Large collections however indicate that there are absolutely no constant differences in the galls of the two, unless the eastern galls average smaller. It has been the custom to assign all material from eastern localities to *radicum*, from western localities to *utahensis*. As a matter of fact, true *utahensis* and true *radicum* resemble each other as closely as *radicum*, from the Atlantic Coastal Plain up to Cape Cod, resembles *johnsoni* from the northern Massachusetts coast. I hope anyone who may object to recognition of my varieties, my "creations" in Cynipidæ, will bear in mind this *radicum-utahensis* case!

My material of this species is limited except from Utah. There are undoubtedly many varieties to be described. In addition to material which I can assign to definite varieties the species has been recorded from Ottawa (Provancher), Ontario (Jarvis), Maine, Ohio (Beutenmuller), Indiana (Cook), Illinois (Weld), Colorado (Ashmead, Gillette, and Cockerell). The following are the references for these localities:

*Rhodites radicum* Provancher, 1889, Add. et Corr., p. 162. Ashmead, 1890, Colo. Biol. Assoc. Bull., I, p. 38. Gillette, 1892, Ent. News, III, p. 247. Webster, 1892, Ohio Agr. Exp. Sta. Bull., 45, p. 156. Cockerell, 1900, Ent. Student, I, p. 10. Cook, 1904, Proc. Ind. Acad. Sci., p. 225; 1904, Ohio Nat., V, figs. 98a, 98b; 1905, 29th Rpt. Ind. Dpt. Geol. and Nat. Res., p. 817, fig. 11. Jarvis, 1907, Rpt. Ent. Soc. Ont., XXXVII, p. 70; 1909, Rpt. Ent. Soc. Ont., XXXIX, p. 90.

Patch, 1907, Me. Agr. Exp. Sta. Bull., 148, p. 279; Stebbins, 1910, Springfield Mus. Bull., II, p. 38.

The Ashmead, Gillette, and Cockerell records for Colorado are certainly for an undescribed variety. Stebbins' record may apply to variety *johnsoni*. Considering the geographic source of these other references, it is possible that none of them apply to variety *radicum*, which is probably confined to the Atlantic Coastal Plain. Britton (1902, Conn. Exp. Sta. Rpt., I, p. 237), records this species from *Rubus*. This is a mistake, and the reference applies probably to *Diastrophus nebulosus* (Osten Sacken). According to Beutenmuller (1909), Bull. Amer. Mus. Nat. Hist., XXVI, p. 137), the following references to this species apply to *Diastrophus turgidus* (Bassett) :

*Rhodites radicum* Riley, 1870, Amer. Ent., II, p. 181, fig. 110. Saunders, 1874, Rpt. Ent. Soc. Ont., for 1873, p. 7, fig. 1; 1883 and 1889, Ins. Inj. Fruits, p. 304, fig. 314. Gillette, 1888, 27th Rpt. Agr. Mich., p. 467.

In the same paper (1909) Beutenmuller applies the following references to *Diastrophus radicum* Bassett:

*Rhodites radicum* Gillette, 1888, 27th Rpt. Agr. Mich., p. 467. Gibson, 1906, Rpt. Ent. Soc. Ont., for 1905, p. 122.

The next references apply to some, probably an undescribed, variety of this species:

*Tribalia batatorum* Walsh, 1864, Proc. Ent. Soc. Phila., II, p. 471. Ashmead, 1885, Trans. Amer. Ent. Soc., XII, pp. 294, 304; 1887, Trans. Amer. Ent. Soc., XIV, p. 134; 1903, Psyche, X, p. 210; 1903, Proc. Ent. Soc. Wash., V, p. 222. Kieffer, 1902, Bull. Soc. Metz, (2), X, p. 96. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 77; 1910, Das Tierreich, XXIV, pp. 697, 842. Thompson, 1915, Amer. Ins. Galls, pp. 21, 44.

Walsh published this name with a poor description of an immature insect, without a definite locality altho it was probably Illinois, and with the statement that the gall was "As I learned from a reliable source, attached, apparently by a woody peduncle, to a common potato, many other such galls having been found on other potatoes." This astounding host record was fortunately questioned by Beutenmuller (1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 649), who stated that "Dr. William H. Ashmead informed me some time ago that he had investigated this matter and was in possession of con-



clusive evidence that Walsh's galls were the same as those of *Rhodites radicum* and that Walsh received his specimen from a farmer, who found them while plowing his potato-patch and sent them to the 'State Entomologist' as being 'potato-galls' owing to their resemblance to a potato". The Walsh types were lost in the Chicago fire. I quite believe that *batatorum* never came from a potato, and represents a rose root gall.

*Diplolepis semipicea* (Harris, 1841, Ins. Mass., p. 400), was described from a rose root gall. Osten Sacken took the insect to be an inquiline of the genus *Periclistus* and the name applied to the gall has been taken to be a synonym of *radicum* in most of the literature. Beutenmuller (1908, Psyche, XV, p. 9) states that the remnants of the type *semipicea* show it to be "the same as *Rhodites fulgens* Gillette". This interpretation appeared correct to me when I examined the type of *semipicea* several years ago, but my examination then was not very critical. If so, *fulgens* must be a distinct variety of *semipicea*. Altho both *radicum* and *semipicea* produce somewhat similar root galls on roses, the insects of the two species are very distinct.

### ***Diplolepis radicum* variety *radicum* (Osten Sacken)**

*Rhodites radicum* Osten Sacken, 1863, Proc. Ent. Soc. Phila., II, pp. 42, 45, 46. Walsh, 1866, Pract. Ent., I, p. 114. Mayr, 1881, 20 Jahrb. Communal Oberealsch., I, p. 18. Ashmead, 1885, Trans. Amer. Ent. Soc., XII, pp. 293, 304; 1887, Trans. Amer. Ent. Soc., XIV, p. 134. Bassett, 1890, Trans. Amer. Ent. Soc., XVII, p. 62. Beutenmuller, 1892, Bull. Amer. Mus. Nat. Hist., IV, p. 246, pl. 9, fig. 3; 1904, Bull. Amer. Mus. Nat. Hist., XX, p. 27; 1904, Amer. Mus. Nat. Hist. Guide Leaflet, 16, p. 6, fig.; 1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 648, pl. XLVII, figs. 7, 8. Dalla Torre, 1893, Cat. Hymen. Cynip., II, p. 127. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 79; 1910, Das Tierreich, XXIV, pp. 716, 839. W. T. Davis, 1908, Journ. N.Y. Ent. Soc., XVI, p. 55. Beutenmuller (in Smith), 1910, Ins. N.J., p. 603. Thompson, 1915, Amer. Ins. Galls, pp. 21, 45. Viereck, 1916, Conn. Geol. Nat. Hist. Surv. Bull., 22, p. 441. Felt, 1918, N.Y. Mus. Bull., 200, p. 144, fig. 148 (7, 8). Lutz, 1918, Fieldbook Ins., p. 468, pl. C, fig. 2.

*Diplolepis radicum* Britton, 1920, Conn. Geol. and Nat. Hist. Surv. Bull., 31, p. 322.

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Face not radiantly striate as in *johnsoni*; first two segments of the antennæ very dark piceous; mesonotum distinctly more coriaceous, rougher, more hairy than in other varieties; parapsidal grooves somewhat broader and more rugose than in

other varieties, only gradually convergent posteriorly, but approaching so closely at the scutellum as to almost touch the median groove; median groove fine, quite distinct for half the length of the mesonotum; anterior parallel lines indicated for a short distance; lateral lines less distinct than in other varieties; scutellum narrow, the median elevation distinct and so narrow as almost to form a ridge; abdomen of moderate length, the second segment covering hardly more than half the area; legs almost uniformly bright brownish rufous; areolet tending to be small.

MALE.—Differs from the males of other varieties as follows: Face not radiantly striate; first two segments of the antennæ almost black; mesonotum distinctly more coriaceous; parapsidal grooves approaching so closely at the scutellum as to almost touch the median groove; median groove distinct for a third or more of the mesonotal length; anterior parallel lines only indicated; second segment covering two-thirds of the abdomen; areolet moderately small.

GALL.—Does not differ particularly from the galls of other varieties; averaging smaller.

RANGE.—D.C.: Washington (Osten Sacken). North Carolina (Beutenmuller). Pennsylvania? (Beutenmuller). New Jersey: Ft. Lee (Beutenmuller). New York: Staten Island (Beutenmuller); Nyack (Zabriskie in Amer. Mus.).

TYPES.—Females, males, and galls at the Museum of Comparative Zoology; adults at the Philadelphia Academy of Natural Sciences, and in my collection; gall at The American Museum of Natural History. Osten Sacken collector; from Washington, D.C.

The insect of this variety is very distinct from any other in the species. I have examined type material, and material from Nyack and Staten Island, but the other localities listed are published records from the Atlantic Coastal Plain, to which region the variety may be confined. It probably occurs only on the main body of the Coastal Plain which reaches its main northern limit on Cape Cod, but also extends as reduced remnants at river mouths further east on the Atlantic Coast into Nova Scotia.

### ***Diplolepis radicum* variety *johnsoni*, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Face rugoso-striate, more radiantly so about the mouth than in other varieties; first two segments of the antennæ with more piceous than in other varieties; mesonotum less distinctly coriaceous, quite smooth and polished; parapsidal grooves quite broad, only gradually convergent at the scutellum; median groove long but very discontinuous; anterior parallel lines practically absent; median anterior elevation of the scutellum less evident; second segment covering one-half to two-thirds of the abdomen; abdomen very elongate; legs bright brownish rufous, the femora and coxæ deep rufous brown;

areolet of only moderate size; first abscissa of the radius slightly more angulate than in other varieties.

MALE.—Differs from the males of other varieties as follows: Face somewhat radiantly striate about the mouth; first two antennal segments often more piceous; parapsidal grooves rather close together at the scutellum; median groove discontinuous; anterior parallel lines practically absent; areolet of only moderate size.

GALL.—Does not differ particularly from the galls of other varieties, averaging smaller.

RANGE.—Massachusetts: Gloucester. Not improbably occurs throughout more northern New England.

TYPES.—24 females, 7 males, 1 gall. Holotype female, paratype adults, and gall at the Boston Society of Natural History; paratype adults at The American Museum of Natural History, the U.S. National Museum, and with the author. Labelled Gloucester, Massachusetts; May 30; C. W. Johnson collector.

I am indebted to Mr. C. W. Johnson, of the Boston Society of Natural History, for permission to describe this variety from material of his collection.

Insects emerged from a gall collected at Gloucester, Massachusetts, on May 30.

Probably no two localities in the United States have been more thoroly collected for Cynipidæ than eastern Massachusetts and the neighborhood of New York City. It is no credit to the taxonomy we have been doing to have ignored the evident differences between material from the two regions. No two adjacent varieties of this species are more distinct than *radicum* and *johnsoni*. I have not yet worked out the extent of the cynipid fauna of eastern Massachusetts; it is probably the same as the fauna of most of more northern New England; variety *radicum* is very probably confined to the remnants of the old Atlantic Coastal Plain.

### **Diplolepis radicum variety utahensis (Bassett)**

*Rhodites Utahensis* Bassett, 1890, Trans. Amer. Ent. Soc., XVII, p. 62.

*Rhodites utahensis* Cockerell, 1900, Ent. Student, I, p. 10. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 79; 1910, Das Tierreich, XXIV, pp. 715, 841. Beutenmuller, 1907 (in small part only), Bull. Amer. Mus. Nat. Hist., XXIII, p. 649, pl. XLVII, fig. 6. Thompson, 1915, Amer. Ins. Galls, pp. 21, 46. Felt, 1918, N.Y. Mus. Bull., 200, p. 144, fig. 148 (6).

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: First two segments of the antennæ bright piceo-rufous; mesonotum obscurely punctate; parapsidal grooves quite broad, quite suddenly curving inward and consequently

close together at the scutellum; median groove lacking, or very short and deep and distinct at the scutellum; anterior parallel lines fine, raised, distinct, especially posteriorly; scutellum more narrow than in *plana*, median raised region not as broad anteriorly; second segment of the abdomen covering about three quarters of the area; abdomen rather short; legs, especially the femora, lighter brownish rufous than in *plana*; areolet large or very large; first abscissa of the radius less heavy than in *plana*.

MALE.—Differs from the males of other varieties as follows: Parapsidal grooves posteriorly suddenly curving inward, and consequently close together at the scutellum; median groove short or discontinuous, areolet large or very large.

GALL.—Does not differ particularly from the galls of other varieties; averages larger.

RANGE.—Utah: Thistle (Weld collector); Provo, Price.

TYPES.—Lost.

Bassett described *utahensis* from several males cut from old galls sent by Mr. Siler "from Utah". The original description was a brief comparison of the males with "*radicum*", but such a comparison as would cover several of the western varieties, especially since it cannot be entirely certain which of the eastern varieties Bassett had in mind. As with other Cynipidæ, there are probably several varieties of this species to be found in Utah, and I have no other reason for taking my Provo and Price material to represent Bassett's name than that this is the common variety in a large part of the more accessible regions of that state. This material does not disagree with anything in the original description. Altho the types are lost it may be as well to retain the Bassett name, restricting it as I have.

Of 4077 insects I have bred of this material, 2554, or about 63 per cent, are males. This high percentage is evidently due to the premature collecting of the galls which appears to prevent a larger number of the less mature females from emerging. Of the first 2948 Provo insects emerging 69.5 per cent were males; of the last 765 Provo insects emerging only 49 per cent were males. More mature galls collected at Price gave only 38 per cent males. These factors in obtaining ratios of the sexes of Cynipidæ must be borne in mind if we are to avoid wrong conclusions. It is safe, however, to estimate that the males are about equal in number to the females in this species. The adults emerged after collecting on April 18 and April 20, 1920. As with other species in this genus this insect probably has no alternation of generations.



A part of the material from Pullman, Washington, matches this Utah material very closely, but until I can examine further collections I should hesitate to state that the range extends into Washington. Beutenmuller's 1907 description of *utahensis* was made from this Washington material, which is at least in part another variety, *divergens*.

**Diplolepis radicum variety plana, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: First two segments of the antennæ bright piceo-rufous; mesonotum obscurely punctate; parapsidal grooves not as broad posteriorly as in *utahensis*, only gradually convergent posteriorly, wide apart at the scutellum; median groove discontinuously evident for half the mesonotal length; anterior parallel lines fine, raised, distinct, especially posteriorly; scutellum broader than in *utahensis*, median raised region broader anteriorly; second segment of the abdomen covering hardly more than one half the area (at least in the available material); abdomen somewhat more elongate than in *utahensis*; legs, especially the femora, much darker piceo-brown than in *utahensis*; areolet large or very large; first abscissa of the radius slightly heavier than in *utahensis*.

MALE.—Not available for description.

GALL.—Does not differ particularly from the galls of other varieties; averaging large.

RANGE.—Oregon: La Grande. Probably confined to an area in Oregon and Idaho east of the highest elevations in Oregon.

TYPES.—3 females, 3 galls. Holotype female, paratype gall at The American Museum of Natural History; paratype adults and galls with the author. Laballed La Grande, Oregon; April 12, 1920; Kinsey collector.

Except for three females, the insects had all emerged before collection on April 12, 1920.

This insect is closely related to *utahensis* and *divergens*; it ranges between those two varieties but is the most distinct of the three.

**Diplolepis radicum variety divergens, new variety**

*Rhodites utahensis* Beutenmuller, 1907 (in large part), Bull. Amer. Mus. Nat. Hist., XXIII, p. 649 (and pl. XLVII, fig. 6?).

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: First two segments of the antennæ bright piceo-rufous; mesonotum relatively smooth; parapsidal grooves rather broad posteriorly, hardly more than gradually convergent posteriorly, wider apart at the scutellum than in *utahensis*, not as wide as in *plana*; median groove rather long, more continuous posteriorly;

anterior parallel lines fine, raised, distinct, especially posteriorly; scutellum rather narrow, median raised area about as in *utahensis*, or more depressed anteriorly; abdomen of moderate length, the second segment covering one-half to two-thirds of the area; legs almost uniformly rufous brown; areolet of moderate size or smaller, smaller than in *utahensis* or *plana*; first abscissa of the radius slightly heavier than in either *utahensis* or *plana*.

MALE.—Differs from the males of other varieties as follows: Parapsidal grooves hardly more than gradually convergent posteriorly; median groove rather long and continuous posteriorly; areolet of moderate size or smaller.

GALL.—Does not differ particularly from the galls of other varieties.

RANGE.—Washington: Pullman. Probably confined to a small region about the Cœur D'Alene and Moscow Mountains of the Idaho and Washington boundary.

TYPES.—6 females, 2 males. Holotype female, paratype females, and males at The American Museum of Natural History; paratype female with the author. From Pullman, Washington; Melander collector; parts of American Museum numbers 24633, 24660, 24661.

The smaller areolet and less convergent parapsidal grooves will distinguish the types of this variety from *utahensis*, which it closely resembles. But material from the same collection appears to include typical *utahensis* and several grades of intermediates with *divergens*. This variation cannot be dismissed as liable to occur in any locality or between any two localities. I have 4077 insects of *utahensis*, from two localities sixty miles apart. No individual of the lot varies toward the typical *divergens* from Pullman. Either the Pullman material represents both varieties, with interbreeding where the ranges meet; or *utahensis* at Pullman is tending toward the development of another variety not yet completely isolated. In either case the distinct thing should be recognized. More material from the region may illuminate the question.

Beutenmuller's 1907 description of *utahensis* fits *divergens*, and was probably based on this same Melander material. Contrary to the statement made there, the gall of this or of any other variety is not distinctive, unless in average size.

### *Diplolepis variabilis* (Bassett)

FEMALE.—Mesonotum sculptured posteriorly between the parapsides; scutellum without foveæ; second segment of abdomen very large, produced dorsally; radial area heavily shaded, clear centrally. HEAD: Fully as wide as or slightly wider than the thorax, hardly enlarged behind the eyes; black, the mouth parts brighter; coriaceous to finely

puncto-rugose, naked except for a short pubescence on the face. Antennæ black, the two or three basal segments brighter; with 13 (or 14) segments, the second globose, only slightly elongate, the third distinctly longer than the fourth (or more than twice the length of the fourth if there are only 13 segments), the last only slightly longer than the preceding. THORAX: Entirely black; mesonotum rather irregularly rugose, most rugose posteriorly between the parapsidal grooves and antero-laterally; parapsidal grooves distinct for two thirds the mesonotal length, anteriorly entirely lost in the rugose areas; median groove almost lacking; anterior parallel lines evident but not prominent, rather narrow; lateral lines fine, in a smoother area; scutellum longer than wide, well rounded posteriorly, rugose, anteriorly depressed especially laterally but without foveæ; pronotum rugoso-striate laterally; mesopleuræ rugose, with a large, smoother, shining, coriaceous area, smoothest ventrally, crossed by a broad, transverse, rugose area. ABDOMEN: Darker posteriorly, practically entirely smooth, shining, and naked; elongate, much further produced dorsally, edges of segments very oblique, the second segment covering three quarters or more of the whole area; hypopygium plow-shaped, without a further spine. LEGS: Punctate, scatteringly hairy; tarsal claws fine, with a bare suggestion of a tooth. WINGS: With the margins short ciliate; largely smoky; veins heavy; the areolet of moderate size to large; the cubitus not quite reaching the basalis; the radial cell open, or closed by a thickening which is not a continuation of the subcostal or radial veins, cell short, broad, the second abscissa of the radius strongly curved; the first abscissa arcuate-angular; radial cell especially smoky on the bounding veins, clearer centrally. LENGTH: 2.5-3.7 mm.

MALE.—Differs from the female as follows: Antennæ wholly black; abdomen black, small, elongate; cloud on veins of radial cell almost or wholly lacking; radial cell more or less closed.

GALL.—Irregularly ovate, smooth, solid, leaf gall. Polythalamous, each gall with usually three or four larval cells. Very irregular in shape, globular, to ovate, elliptical, or massive, all edges rounded; averaging 10. by 20. mm., observed to 25. mm. in diameter; smoothed, naked of bloom or scurf, light to rich brown (in mature galls). Internally solid, compact, soft, like compacted sawdust; the larval cells large, 2.0-3.5 mm. in diameter, more round than usual, with a distinct but thin and inseparable lining. On roses, attached to leaves, or replacing leaflets, or replacing the whole leaf and attached directly to stems.

RANGE.—From Texas and Wyoming to Washington. A very closely related species, *Diplolepis ignota* (O. S.), extends over the eastern half of the United States.

I have not seen the insects of this species which have been recorded from Texas (according to Beutenmuller), Wyoming, or Washington, altho I have seen the galls of the Washington material. Undoubtedly these regions as well as others in the western part of the United States have varieties distinct from any yet described. What data have been over-

looked by the approximate taxonomy which fails to distinguish the several varieties concerned!

Important information as to the age of the species and factors in the origin of species are mentioned in connection with variety *lutescens*.

*Diplolepis ignota* (Osten Sacken) with its varieties occurring thruout the eastern part of the United States is so closely related to *variabilis* that there cannot be found differences in the insects which one could presume are of more than varietal rank. With a single change in regard to the sculpture of the mesopleuræ, the general description of this species will apply to all varieties of *ignota*. On the other hand, the galls of *ignota* varieties are covered with a white scurf which the galls of all varieties of *variabilis* lack, and all of the white-galled varieties occur in the eastern half and all of the brown-galled varieties in the western half of the United States. This indicates closer affinities within each group than between the groups. One must choose between considering the groups as species and over-emphasizing their distinctness; and considering it a single species involved and attempting to express the groupings of the varieties by a system of quadrinomials, which is objectionable. If we will keep in mind the close relations of the two it may prove most convenient to use two specific names.

Of 1622 insects which I have bred, 784, or over 48 per cent, are males. I have a relatively small amount of material of *ignota*, and I had previously believed that the high percentage of males obtained there was abnormal. But it would appear as if these species have a more nearly equal sex ratio than some others of the genus. As with other rose cynipids I have bred, the males appear to emerge earlier than the females, accounting for instance for the 57 per cent males collected at Provo, and the 43 per cent collected at Holly. The insects emerge early in the spring, in late April in the Rocky Mountain country, probably earlier or later in regions of earlier or later seasons. I have recounted the life history of *ignota* (Bull. Amer. Mus. Nat. Hist., XLII, p. 331), and that species in Massachusetts does not have an alternation of generations. The field data for *variabilis* do not disagree, and it is probable that an alternation does not occur for any variety of either group.



**Diplolepis variabilis variety variabilis (Bassett)**

*Rhodites variabilis* Bassett 1890, Trans. Amer. Ent. Soc., XVII, p. 61. Cockerell, 1900, Ent. Student, I, p. 10. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 79; 1910, Das Tierreich, XXIV, pp. 720, 840. Beutenmuller, 1904, Bull. Amer. Mus. Nat. Hist., XX, p. 23; 1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 635, pl. XLVI, figs. 5-9. Thompson, 1915, Amer. Ins. Galls, pp. 22, 23, 46. Felt, 1918, N.Y. Mus. Bull., 200, p. 146, fig. 150 (5-9).

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Head finely coriaceous rugose; mouthparts rufous, the tips of the mandibles piceous, basal segments of the antennæ yellow rufous; thorax rather finely rugose posteriorly between the parapsidal grooves; parapsidal grooves of moderate width, not as wide or rugose as in *sculpta*; scutellum moderately rugose; abdomen bright rufous, darker rufous posteriorly; legs entirely bright rufous, the coxæ darker basally; wing veins rather light brown; areolet of moderate size or rather large; cloud on veins of radial cell light brown; length 2.5-2.8 mm., averaging distinctly smaller than in *sculpta*.

MALE.—Differs from the males of other varieties as follows: Thorax only moderately rugose; areolet large; wing veins of moderate weight, light brown; length 1.7-2.5 mm.

GALL.—Does not differ particularly from the galls of other varieties.

RANGE.—Utah: Provo. Idaho: Cedar Mountains.

TYPES.—At the Philadelphia Academy, The American Museum of Natural History, and the Museum of Comparative Zoology. Collected in "Southern Utah".

I secured adults sometime after collecting at Provo on April 18, 1920.

This variety very much resembles variety *sculpta*; the two can be separated by the accompanying descriptions. I have secured both varieties from Provo. Of 563 of these Provo insects only 20 were variety *variabilis*. My work with other rose cynipids indicates that Provo is the meeting point of two distinct but related faunal areas which are not isolated geographically. As with *Diplolepis tuberculatrix* I find that the less abundant variety at this locality is the northern variety. Bassett recorded southern Utah for his material, but I question the interpretation to give to his "southern". Material of this variety in The American Museum is labelled Cedar Mountains, Idaho; I take it these are the mountains near Moscow; some of the mountains in that region contain a distinct, restricted fauna, but as with this variety, the northern Utah insects appear to extend at least as far north as Moscow and Pullman.

The differences between the varieties *variabilis* and *sculpta* are not great, but in all of the nearly six hundred individuals which I have examined only four are not clearly one thing or the other. My *variabilis* material matches all of the Bassett types which I have seen, but Bassett suggested in his original description that he had two things. I define his variety as I do, not only because of the types I have seen, but also because the following points in the original description apply to this rather than to the other variety: "*Head* \* finely and evenly punctate on the vertex\*\*. *Thorax* \* finely rugose \*\*\* radial area faintly clouded on the second transverse vein in the male \*\*. Length: body male .10, female .11 inch." As an appendix to this description he states that "The description of the female does not apply to all the specimens of this sex reared from these galls, as in some the radial area has no cloud, but a simple broadening of the veins bounding it", which might be one way of stating that the cloud in the other variety, *sculpta*, is as heavy as the veins.

### **Diplolepis variabilis** variety **sculpta**, new variety

**FEMALE.**—Shows the following characters in addition to those common to all varieties of the species: Head finely puncto-rugose, much more rugose than in variety *variabilis*; mouthparts rufous, the tips of the mandibles piceous; thorax coarsely, rugosely sculptured posteriorly between the parapsidal grooves; parapsidal grooves wider, more rugose than in variety *variabilis*; scutellum rather more rugose and more depressed anteriorly than in *variabilis*; abdomen bright rufous, darker rufous posteriorly; legs a peculiar, rich brownish rufous, the coxæ darker basally; wing veins dark brown, heavier than in *variabilis* or *rufopicea*; areolet rather large; cloud on veins of radial cell dark brown, almost as heavy in places as the veins; length 2.7-3.5 mm., averaging distinctly larger than in *variabilis*.

**MALE.**—Differs from the males of other varieties as follows: Thorax more rugose, and the parapsidal grooves wider than in *variabilis*; wing veins dark brown, decidedly heavier and more decidedly clouded than in the male of *variabilis*; areolet rather large; length 2.5-3.5 mm., averaging decidedly larger than the male of *variabilis*.

**GALL.**—Does not differ particularly from the galls of other varieties.

**RANGE.**—Utah: Provo.

**TYPES.**—150 females, 150 males, 30 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Provo, Utah; April 18, 1920; Kinsey collector.

Of 545 insects bred, 312, or over 57 per cent, are males. These insects emerged at some date after collecting on April 18, 1920.

This variety is very closely related to variety *variabilis*. A discussion of the characters and ranges of the two is given under *variabilis*.

### **Diplolepis variabilis variety rufopicea, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Mouthparts dark rufo-piceous; basal segments of the antennæ rufo-piceous; mesonotum very rugose posteriorly between the parapsidal grooves; parapsidal grooves of moderate width; scutellum very rugose, rather more depressed anteriorly than in variety *variabilis*; abdomen mostly piceous black, rich brown rufous basally; legs dark rufous brown, coxæ and hind femora and tibiæ piceous black; wing veins dark brown; areolet of moderate size, elongate on the cubitus; cloud on veins of radial cell dark brown, almost as heavy in places as the veins; length 3.2-3.7 mm.

MALE.—Differs from the males of other varieties as follows: Thorax more rugose; areolet of moderate size, elongate on the cubitus; wing veins heavier, dark brown; length 2.7-3.5 mm.

GALL.—Does not differ particularly from the galls of other varieties.

RANGE.—Colorado: Manitou.

TYPES.—4 females, 8 males, 18 galls. Holotype female, paratype males, and galls at The American Museum of Natural History; paratype adults and galls with the author; paratype males and galls at Stanford University and the U.S. National Museum. Labelled Manitou, Colorado; April 24, 1920; Kinsey collector.

Most of the insects had emerged before collecting on April 24, 1920, but some large larvæ were still in the galls and did not mature until later.

The insect of this variety is very distinct, to be recognized with the naked eye as differing from the Utah varieties. The gall is common in the Garden of the Gods at Manitou, and must have been observed before this by entomologists. How large an area of Colorado is covered by this variety I cannot say definitely. Probably it is confined to a limited area east of the Continental Divide. The Utah varieties and the variety of the High Plains country of eastern Colorado are very closely related, while *rufopicea*, occupying an intermediate geographic position is remarkably distinct. This is strikingly in accord with the geologic histories of the areas involved.

**Diplolepis variabilis** variety **lutescens**, new variety

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Head moderately coriaceous rugose; mouthparts rufous, the tips of the mandibles piceous; thorax rather finely rugose posteriorly between the parapsidal grooves; parapsidal grooves of moderate width; scutellum moderately rugose, not greatly depressed anteriorly; abdomen bright rufous, darker rufous posteriorly; legs entirely bright rufous, the coxæ hardly darker basally; wing veins dark brown, rather heavy, not as dark as in *sculpta*; areolet moderately small; cloud on veins of radial cell not as dark as the veins; length 2.3-3.0 mm., averaging distinctly smaller than any other variety except *variabilis*.

MALE.—Differs from the males of other varieties as follows: Thorax only moderately rugose; areolet of moderate size to small or even closed; wing veins heavy, the first abscissa of the radius usually very broad; length 2.0-3.0 mm.

GALL.—Differs from the galls of other varieties only in averaging distinctly smaller.

RANGE.—Colorado: Holly. Probably restricted to an area of the High Plains country east of the Rocky Mountains.

TYPES.—194 females, 168 males, 38 clusters of galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Holly, Colorado; April 25, 1920; Kinsey collector.

Mature larvæ were in the galls and a few adults had begun to emerge on April 25, 1920; the majority of the insects probably emerged soon after that date. Of 1,048 individuals bred, 453, or about 43 per cent, are males.

The closest relative of this insect is variety *variabilis*. This is the more striking because at least one other variety of the species, *rufopicea*, ranges between *variabilis* and *lutescens*, but *rufopicea* is in all respects the most distinct variety of the species. Holly, the type locality of *lutescens*, is in Colorado, very near the Kansas line, in the flat, barren, and largely treeless High Plains country which is very distinct geologically and geographically from the neighboring Rocky Mountains at the base of which *rufopicea* occurs. This region is of a geologic formation which also occurs in parts of Utah, and the close relations of the Utah and eastern Colorado varieties may date from a time when they were one, in a continuous area, before the Rocky Mountains intervened and allowed two distinct forms to become isolated. These two varieties



appear to be older than the Rocky Mountains, having changed only slightly since they were isolated.

*Lutescens* is separated from *variabilis* by the smaller areolet and the darker cloud on the radial cell in the female, and by the peculiarly heavier first abscissa of the radius in the male.

### **Disholcaspis pattersoni, new species**

**FEMALE.**—Mostly bright brown rufous and darker; abdomen naked with large patches of hairs latero-basally; areolet large; length about 3.5 mm. **HEAD:** Not quite as wide as the thorax, greatly enlarged behind the eyes; dark brownish rufous, almost black below the insertions of the antennæ, around the mouth, and on the tips of the mandibles; finely rugoso-punctate, more rugose on the face; moderately dense with long hairs, hairs fewest on vertex and cheeks. Antennæ wholly black, or basal segments either rufous or dark rufo-piceous; with 13 (or 14) segments, the third distinctly longer than the fourth, the last more than twice the length of the preceding (or incompletely divided). **THORAX:** Mesonotum rich brownish rufous, black on the anterior parallel and lateral lines, sometimes black antero-medianly; distinctly rugoso-punctate, not densely covered with long hairs; parapsidal grooves deep, moderately broad posteriorly, extending half the length of the mesonotum; median groove lacking; anterior parallel lines rather smoother, reaching half way to the scutellum; lateral lines broad, smooth, naked; scutellum brownish rufous, blackish toward the base, rugose, hairy, about as broad as long, elevated, the depression at base more finely rugose, without distinct foveæ; pronotum brownish rufous, shallowly punctate and hairy laterally; mesopleuræ wholly brownish rufous, irregularly punctate and hairy. **ABDOMEN:** Bright to dark rufous, brightest and lightest basally, smooth and shining, only very microscopically punctate, entirely naked except for large patches of hairs latero-basally, and the hairs on the ventral spine; as high or higher than long, the second segment not covering half the abdomen, not produced dorsally but with the ventral edges of all the segments well rounded. **LEGS:** Rufous, also rufous on the coxæ, tarsi dark, tips darkest, rugoso-punctate, hairy; claws strong, toothed. **WINGS:** Clear, ciliate, veins deep brown; areolet large; cubitus extending only a little more than half way to the basalis; radial cell open, wide, the second abscissa of the radius strongly curved distally, neither radius nor subcosta reaching the edge; first abscissa of the radius strongly angulate, with a short but distinct projection. **LENGTH:** 3.0-3.7 mm.

**GALL.**—Large, bluntly conical, bullet gall, in compacted clusters about the twig. Each gall primarily a true cone, but distorted by pressure of surrounding galls, a slight projection basally extending into the twig, and a slight overlapping of the primarily circular base about the twig; dark purple when fresh, becoming rich brown, darker at the tips; smooth; averaging 8. mm. in diameter by 12. mm. high. Internally solid, the larval cell oval, 2. x 4. mm., with a distinct, shell-like wall, not

at all separable; cell located below the mid-point of the gall but not at the very base. On twigs of *Quercus breviloba*.

RANGE.—Texas: Austin (Patterson); Round Rock, Leander.

TYPES.—18 females, 19 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, and with the author. Labelled Austin, Texas; *Q. breviloba*; Patterson collector.

The gall of this cynipid has been known to me for several years, but previously I have not had the adult. I am glad to be able to name this for Dr. Patterson who successfully reared the insect. In 1921 Dr. Patterson found young galls on July 28, mature galls on August 29, pupæ by October 21, mature adults in the galls by November 5, and emerging adults on December 12. I collected galls in abundance on December 6 and 8, 1919, at Round Rock and Leander, not far north of Austin, but all of the adults had emerged previously. Emergence dates must vary considerably with the development of the seasons in different years.

This is probably a variety of *Disholcaspis bassetti* Gillette, but until I can see the types and more material of *bassetti* I cannot be certain of the relationships of *pattersoni*.

### ***Disholcaspis simulata*, new species**

FEMALE.—Rufous to black; parapsidal grooves, anterior parallel, and lateral lines distinct; thorax hairy, abdomen mostly naked; areolet large. HEAD: Much narrower than the thorax, widened behind the eyes; rufous brown or darker to black; roughly granulose, or finely but roughly rugose, all but the vertex hairy with long hairs. Antennæ bright rufous brown to rufous black; entirely hairy; (13-) 14-jointed, the second segment almost globose, the third longest but hardly longer than the fourth, the last approaching twice the length of the preceding. THORAX: Broad, rufous to black, mesonotum practically smooth, closely punctate, rather densely covered with long hairs; parapsidal grooves distinct, deep, smooth, naked, fairly broad at the scutellum, narrowing and continuous anteriorly for half the length of the mesonotum; median groove absent; anterior parallel lines distinct, smooth, naked, extending half way to the scutellum; lateral lines distinct, smooth, naked, half the length of the mesonotum; scutellum cushion-shaped, rugoso-punctate, densely hairy, depressed anteriorly, with two oblique, shallow foveæ; pronotum finely punctate, hairy; mesopleuræ entirely punctate and hairy. ABDOMEN: Rufous to piceous black; smooth, shining, naked, except for distinct patches of hairs latero-basally and the hair on the ventral spine; as high as long, not produced dorsally; hypopygium produced, ventral spine prominent but not long, ventral valves at an

angle greater than  $60^{\circ}$ ; segments two to four with the ventral edges well rounded. LEGS: Rufous brown or rufo-piceous, darker on the tarsi; claws prominently toothed. WINGS: Clear, hairy, ciliate, veins heavy; areolet large or very large; cubitus fading out just at or short of the basalis; radial area open, the subcosta and radius not stopping far short of the margin; second abscissa of the radius well curved; the first abscissa slightly infuscated at the subcosta, strongly angulate but with hardly a projection. LENGTH: 3.2-4.0 mm.

GALL.—Rounded bullet gall with a nipple tip. Monothalamous. Fairly globular, averaging 12-15. mm. in diameter, some specimens larger or smaller, bearing at the summit a short, blunt point; colored light brick red or yellowish brown, weathering dark; the surface is very rough, but finely so. Internally densely but not compactly woody, likely solid when young, becoming hollow when mature, but with the walls still thick; containing a thin-walled, hard-shelled, entirely loose larval cell averaging 3. mm. in diameter by 4.2 mm. long. Galls attached by a tongue in the concave base; laterally on twigs of white oaks.

RANGE.—Oregon, California. Probably wherever oaks occur on the Pacific Coast.

### ***Disholcaspis simulata* variety *simulata*, new variety**

FEMALE.—Is distinguished from other varieties of the species as follows: Head bright rufous brown, darker only on the tips of the mandibles; antennæ bright rufous brown, dark brown apically; thorax entirely bright rufous brown, sometimes darker on the thoracic grooves and lines; lateral lines only moderately broader; foveæ of the scutellum of moderate size, almost but not quite smooth; abdomen bright rufous, rather rufo-piceous dorsally, ventrally, and posteriorly; legs bright rufous brown, darker on the tarsi especially toward the tips; wing veins heavy, deep and rich brown.

GALL.—Mostly colored light brick red to a darker purplish red, becoming lighter and browner on aging, or weathering dark; on twigs of *Quercus dumosa*.

RANGE.—California: Fallbrook, Sorrento, San Jacinto Mountains, Upland, Pasadena, Santa Barbara, Paso Robles. Probably occurs throughout the southern Sierras and their extensions, from El Portal south.

TYPES.—4 females and 29 galls. Holotype female, paratype female, and galls in The American Museum of Natural History; paratype females and galls with the author; paratype galls at Stanford University, the Museum of Comparative Zoology, the Philadelphia Academy, and the U.S. National Museum. Labelled Upland, California; February 3, 1920; Kinsey collector.

Galls collected in February and March, 1920, contained live adults in November and December 1920 and in March 1921; several adults had emerged before March 1921. It is not unlikely that it is a year and a half or more after hatching before the adult emerges from the gall. Externally some specimens,

duller-colored, of this gall will be confused with less distinctly colored specimens of *Disholcaspis plumbella* Kinsey; both species occur in enormous abundance on the same host, *Quercus dumosa*; the adults of the two are very distinct.

***Disholcaspis simulata* variety *vancouverensis*, new variety**

FEMALE.—Is distinguished from other varieties of the species as follows: Head dark rufous, black medianly on vertex and face; antennæ rufous black, dark rufous basally; thorax rufous black, dark rufous on the parapsidal grooves and forward, and on the mesonotum basally, and dark rufous on the sides; lateral lines quite broad, broader than in variety *simulata*; foveæ of the scutellum more narrow, quite rugose at base; abdomen piceous black, piceous rufous ventro-posteriorly; legs rufo-piceous, darkest on the tarsi; wings with veins piceous black, heavier.

GALL.—Mostly colored light buff to yellowish brown, in part tinged rose red (not brick red!) when younger, weathering darker; on twigs of *Quercus garryana*.

RANGE.—Oregon: Roseburg, Grants Pass, Ashland. California: Yreka. North of the other varieties.

TYPES.—2 females and 6 galls. Holotype female, paratype galls at The American Museum of Natural History; paratype female and galls with the author; paratype galls in Stanford University and the U.S. National Museum. Labelled Ashland, Oregon; April 6, 1920; Kinsey collector.

Tho structurally the two varieties are very much alike, their distinct color, correlated with the distinct hosts and ranges makes it important to distinguish two separated tendencies in evolution. This variety is likely confined to the geographic area of the more northern Pacific coast called "Vancouveran" by Van Dyke (1919, Ann. Ent. Soc. Amer., XII, p. 4). Another variety occurs on *Q. Douglasii* in central California, and still another distinct variety in the San Bernardino Mountains, but I have not seen adults from galls of these.

***Heterœcus*, new genus**

FEMALE.—Generally brownish rufous; antennæ with 14 segments, darker apically; parapsidal grooves not continuous; foveæ large, more or less rugose at base; second segment covering a large part of the abdomen; tarsal claws strong, simple. HEAD: Not quite as wide as the thorax, only slightly enlarged behind the eyes; rufous to dark brown, dark about the mouth; finely rugoso-punctate, scatteringly hairy, most so about the mouth. Antennæ fairly stout, long, finely pubescent, often darker on the seven or eight terminal segments, and lighter



basally; with 14 segments, the first not twice the length of the second, the second somewhat elongate but short, the third only slightly longer than the fourth, the last only one third longer than the preceding. THORAX: Broad, brownish rufous to very dark brown, sometimes in part blackish, scatteringly hairy, most densely hairy on the sides; mesonotum finely, closely puncto-rugose, shagreened in places; parapsidal grooves fairly deep, more or less rugose at bottom, convergent posteriorly, moderately close together at the scutellum, not extending to the pronotum; median groove distinct and shortened, or lacking; anterior parallel lines rather fine to scarcely evident, extending more than half way to the scutellum; lateral lines distinct, long, almost parallel to the parapsides, somewhat curved inward anteriorly; scutellum rugose, the basal depression broad, deep, smooth and more or less rugose at bottom, separated by a very fine ridge into two, large foveæ; pronotum laterally rugoso-punctate, rather dense with long hairs; mesopleuræ densely, closely, irregularly aciculate, naked over most of the area. ABDOMEN: Darker or lighter rufous; smooth, very microscopically punctate on the ventral margins of the segments; naked except for a very few hairs latero-basally, on the edges of the posterior segments, on the ventral spine and valves; somewhat longer than wide, produced only slightly dorsally, the second segment covering most of the abdomen; posterior edges of segments at a  $75^{\circ}$  angle, the ventral edges only slightly rounded; ventral spine rather long, slender. LEGS: Almost wholly yellow rufous, tips of tarsi darker, the tarsal claws moderately strong, simple. WINGS: Clear, faintly hairy, edges hardly ciliate, veins brownish; areolet closed to large, cubitus very faint, not reaching the basalis; radial cell open, neither vein reaching the margin, second abscissa of the radius distinctly curved, first abscissa of the radius arcuate to distinctly angulate. LENGTH: 1.7-3.7 mm. These characters are common to all of the following species and varieties.

GALL.—Monothalamous bud gall, cylindrical, more or less elongate, two-parted in one species; slender tipped, the tip more or less curved; smooth, with or without scurf or wool covering. Internally with an elongate cavity usually extending most of the length of the gall, the larval cell usually nearer the apical end of the cavity; the adults emerge from near the base of the gall. Sessil, laterally, or terminally, on twigs of *Quercus chrysolepis*.

RANGE.—California, (Arizona?).

TYPE.—*Andricus dasydactyli* Ashmead.

The species included in this genus are remarkably similar in the morphology of the insects; the large amount of detail in the description of the genus applies to all species, emphasizing their close relationships. More distinct differences in insect structure are shown between the varieties of many species than between the species of the genus. That the differences between the insects of two species are nevertheless real enough was evidenced when one of my freshman students, without

other experience than four months in a course in taxonomy, fully distinguished between undetermined material of *dasydactyli* and *pacificus*, two of the most closely related species.

The galls of each species, however, are very distinct, *Heteræcus*, "many homes", referring to this characteristic. All of the galls conform to a single type. The gall is the best data we have as to the physiology of a gall wasp, as I have shown before (Bull. Amer. Mus. Nat. Hist., XLII, p. 365); and that this measure is sometimes extremely fine is abundantly illustrated with many of the varieties I describe in this paper. Many species also in this paper show that either the morphology or the physiology may exhibit the greater degree of variation, or that in other instances the amount of variation may be equal for the two sorts of characters. There can be no objection, then, to recognizing as a distinct unit a group defined by abundant morphologic and physiologic characters, where the species are best distinguished by physiologic data, and the varieties of a species by morphologic data. It may be objected that the insects should define species and the galls the varieties. If one should attempt such an arrangement he would be completely confounded, I think, by the difficulties in choosing a particular structural character to unite forms; the utilization of several such characters in combination would be impossible, for a large number of combinations exist, with few coincidences. Such a method would combine forms with distinctly different galls, and have to ignore facts of distribution. By utilizing the galls in deciding species lines, the conclusions reached are confirmed by some morphologic characters of the insects, and especially by distribution data.

This genus presents an instructive instance of the need for considering characters of several sorts in taxonomy, in contrast to the practice among too many taxonomists! Without the galls as guides, it is probable that a solution of the situation in this group would not yet have been reached.

Whether to interpret this group as a species or a genus is largely a matter of individual opinion and convenience. Certain it is that we must recognize three sorts of relationships: the unity of the whole group, the divisions marked by the galls, and within each division another division indicated largely by insect characters and confirmed by a reasonable

conception of distribution facts. To designate these as species, subspecies, and varieties is not as convenient a method as to consider the group a genus.

The distribution of the varieties of most of the species is in strict accord with my findings for other Cynipidæ, limiting each variety to one faunal area. In *Heteræcus bakeri* there is considerable variation within the single area, and not a distinct type in the San Bernardino range as would be expected. Altho I have some hundreds of the insects and some thousands of the galls, I do not yet have material enough to recognize all of the varieties which probably exist for any one species. There are at least four, possibly six faunal areas in which *Quercus chrysolepis* occurs, and each species is likely to have as many varieties if it occurs over the entire range of its host. Geographic isolation appears to have been a factor in preserving these variations.

The confinement of the genus in California to the single host, *Q. chrysolepis*, suggests that isolation upon distinct hosts has had nothing to do with the origin or preservation of the species. Often several species occur on a single tree. Whether species interbreed, whether each type will breed true in successive generations, cannot be stated without experimental data. Intermediates however do not exist in my collection (except in *bakeri*, as noted), and each type of adult is definitely connected with a particular type of gall. Exactly the same and parallel conditions have held in the past, as earlier collections show, collections made in some instances (*pacificus* and *dasydactyli*) thirty-five years previously. I am inclined to expect to find that each species remains distinct.

It is to be noted that this amount of variation occurs in an agamic group. Field data would suggest that an alternate, bisexual generation does not exist. Whether bisexual reproduction ever occurs is a matter of some importance genetically, and one which some student on the field should determine as soon as possible.

I have attempted a key to the forms described, but cannot effect an arrangement which is not very artificial, nor one which would be intelligible without considerable series of several species at hand. The following conspectus may prove more satisfactory, and not too inconvenient for this number of forms.

1. Thorax with considerable black; parapsidal grooves wide; median groove short or lacking; areolet moderate or large. Gall naked, robust, ovate, abruptly tipped. *H. bakeri*
2. Thorax without black unless in the foveæ; veins only moderately heavy; areolet always of moderate size. Galls covered with long-threaded wool. *H. dasydactyli*
  - a. Parapsidal grooves rugose at bottom; median groove short, distinct; foveæ rugose at bottom; length over 2.7 mm. Galls long and slender, straight, occurring singly. Northern Sierras. var. *dasydactyli*
  - b. Parapsidal grooves at bottom; median groove about lacking; foveæ rugose at bottom; length over 2.5 mm. Galls moderately short, almost straight, singly or in small clusters. Southern Sierras. var. *eriphorus*
  - c. Parapsidal grooves at bottom; median groove short, distinct; foveæ smooth at bottom; length under 2.5 mm. Galls very short, curved, in large, compact clusters. San Bernardinios. var. *pygmæus*
3. Thorax without black; wing veins only moderately heavy; the areolet quite small. Galls globose, with a fine scurf. Northern Sierras. *H. chrysolepidis*
4. Thorax with some black; parapsidal grooves only moderately wide; median groove distinct; wing veins moderately heavy; areolet small or lacking. Gall naked, globular, hardly with a tip. Southern Sierras (only?). *H. malus*
5. Thorax very dark brown with black; parapsidal grooves very broad; median groove distinct; wing veins moderately heavy; areolet rather large; length over 3.5 mm. Galls "date seeds", with small scurf. *H. melanoderma*
6. Thorax without black; parapsidal grooves wide; wing veins darker brown; areolet moderate or large. Gall naked, elongate spindle-shaped. *H. pacificus*
  - a. Parapsidal grooves rugose at bottom; median groove short or lacking; areolet large, equilateral; length over 3.2 mm. Gall large, slender, straight. Northern Sierras. var. *pacificus*
  - b. Parapsidal grooves rugose at bottom; median groove short or lacking; areolet moderate, equilateral; length over 3.0 mm. Gall shorter, robust, tip often curved. Southern Sierras. var. *subpacificus*



- c. Parapsidal grooves smooth at bottom; median groove longer; areolet elongate on cubitus; length under 3.2 mm. Gall small, with a longer point. Northern California coast. *var. gracilis*
7. Thorax with some black; parapsidal grooves moderately wide, median groove present, short; wing veins moderate or heavy. Gall turban-like, two-parted.

*H. sanctæ-clarae*

- a. Foveæ smooth; mesopleuræ heavily aciculate, little black on edges; second segment covering two thirds the abdomen. Northerly California. *var. sanctæ-clarae*
- b. Foveæ rugose; mesopleuræ finely aciculate, heavily edged black; second segment covering more than three quarters the abdomen; areolet smaller. Southern Sierras. *var. fuscior*
- c. Foveæ smooth; mesopleuræ finely aciculate, more heavily edged black; second segment covering two thirds the abdomen. San Bernardino mountains. *var. aliud*

**Heteræcus bakeri (Kieffer)**

*Callirhytis bakeri* Kieffer, 1904, Bull. Soc. Metz, (2), XI, p. 132; 1904 (in Baker), Invert. Pacif., p. 44. Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 586, 807, 830. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 360. Felt, 1918, N.Y. Mus. Bull., 200, p. 76.

*Callirhytis Bakeri* Trotter, 1910, Boll. Lab. Portici, V, p. 110, pl. 1, fig. 18.

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color of head and thorax rich brownish rufous, black on the anterior parallel and lateral lines and in the foveæ; parapsidal grooves quite wide, often very wide at the scutellum; median groove very short or lacking; anterior parallel lines very distinct; foveæ of the scutellum rather deep, more or less smooth and black at bottom; abdomen rufous brown, deep brown in part; wing veins yellow brown, not as dark as in *H. pacificus*, but darker than in *H. dasydactyli*; areolet of moderate size or moderately large; first abscissa of the radius arcuate-angulate, distinctly but not strongly angulate, without a projection; length 2.2-3.0 mm., averaging nearer 3.0 mm.

GALL.—A naked, robust, ovate gall with a slender tip. Monothalamous. Body of gall spherical to more elongate-ovate, more abruptly flattened apically, 9-13. mm. in diameter, more or less constricted basally; bearing a slender point apically, arising more or less abruptly from the body of the gall, averaging 1.5 mm. in diameter by 5. mm. long; entirely smooth or with a few tubercles, or with part of the surface roughly rugose, or the whole surface granulose; when fresh, bright to dark green, speckled red, or reddish or purplish brown with buff yellow or light green speckling; on aging becoming more uniformly

yellowish brown. Internally similar to compacted sawdust, with a cylindrical central cavity extending from the base almost to the tip. Scattered, on twigs of *Quercus chrysolepis*.

RANGE.—California: Yosemite (Trotter); El Portal, Pasadena, Upland, San Bernardino, San Jacinto Mountain.

TYPES.—Berlin Museum? Cotypes at Pomona College. Material from the same collector (Baker), and the same locality (Claremont), in The American Museum of Natural History, and in Stanford University.

I have seen the Pomona College cotypes, and the Baker material in The American Museum of Natural History, and they agree with my Upland material. Indeed, my locality, Upland, and Baker's Claremont, are nearby towns neither of which have *Quercus chrysolepis*, but these are post office names for very probably the same region in the nearby mountains.

Most of the adults were emerged in the San Bernardino mountains on January 31, 1920, and at Upland on February 3; most of the insects were not yet emerged at Pasadena on February 7, and adults were still alive in the galls at El Portal on March 21. As usual, emergence is later in more northerly localities.

Both the galls and adults of this species show considerable variation. The above description applies to an average of the material from Upland, that is, near the type locality. The areolet varies from small to large, the foveæ are smooth or sparingly rugose or completely, closely rugose; the parapsidal grooves extend further in some individuals than in others. The galls vary from smooth to very rough or tuberculate, the tip arises very abruptly or only gradually from the body of the gall, the greatest diameter comes at the middle or nearer the apex of the gall. All of these variations occur at each of the localities: San Bernardino mountains, San Jacinto mountains, Upland, Pasadena, El Portal. I cannot perceive any regularity in the concurrence of characters, and have not yet discovered any tendency for a single type to occur in the San Bernardino range, contrary to the usual situation. Galls from Placerville, and part of the material from El Portal, may belong to a northern variety of this species. Some adults from Placerville may belong to a northern variety of *bakeri*, but unfortunately these galls and adults were not definitely connected in the breeding, and I shall need to see more material before deciding the point.

**Heteræcus chrysolepidis (Ashmead)**

*Andricus chrysolepidis* Ashmead, 1896, Proc. U.S. Nat. Mus., XIX, p. 119.  
 Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen, Cynip., p. 62;  
 1910, Das Tierreich, XXIV, pp. 553, 824, 828. Fullaway, 1911, Ann.  
 Ent. Soc. Amer., IV, p. 346. Thompson, 1915, Amer. Ins. Galls,  
 pp. 9, 31. Felt, 1918, N.Y. Mus. Bull., 200, p. 68.

FEMALE.—Differs from *Heteræcus dasydactyli* variety *dasydactyli* only in having the areolet quite small and the second abscissa of the radius very slightly more angulate.

GALL.—A small, irregularly globular or ovate bud gall. Monothalamous. A slight nipple at the apex; the surface covered with a fine, scurfy pubescence, light brown in color; 7. mm. in diameter by 10. mm. long.

RANGE.—California: Colfax (Koebele coll.); Diablo? (F. A. Leach coll.).

TYPES.—Adults and galls in the U.S. National Museum. Labelled 3066 and 3816.

I have examined a type adult and a type gall. The insect is very close to *dasydactyli*, but Mr. Rohwer reports that the areolet is constant in size in all three of the types. The gall is the most distinctive thing of the species. Galls from Diablo appear to match the type galls, but I do not have insects to check the determination. Unlike the type galls, some of the Diablo specimens are clustered, suggesting *H. malus*, and inasmuch as the insects of the two are rather similar perhaps *malus* should be considered a variety of *chrysolepidis*.

**Heteræcus dasydactyli (Ashmead)**

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color of head and thorax rich brownish rufous; parapsidal grooves fairly deep, moderately wide posteriorly, less rugose at bottom than in two varieties of *pacificus*; median groove distinct in two varieties, lacking in one; anterior parallel lines very fine; foveæ sparingly rugose in two varieties, almost smooth in one; abdomen rich brownish rufous, darker dorsally; wing veins brownish yellow, only moderately heavy, lighter than in any variety of *pacificus*; areolet of moderate size; first abscissa of the radius arcuate, with a slight suggestion of an angle; length 1.7-3.5 mm.

GALL.—Spindle shaped, covered with long wool. Monothalamous, occasionally bithalamous. Cylindrical, with a constricted base and an apex which is long in one variety, the tip often curved; smooth, sometimes with a few, scattered, blunt tubercles; light green when young, turning light straw brown to darker; completely covered by a thick mass of long-threaded wool, light buff yellow tinged with pink when young, golden brown when older, attached only to the slightly projecting base of the gall; the wool deciduous from older galls. Internally

almost solid; more porous tissue surrounding a cylindrical cavity extending from the base of the gall hardly more than half way to the tip, with the larval cell in the apical part of the cavity. Singly or in clusters, on twigs of *Quercus chrysolepis*.

RANGE.—California: San Jacinto Mountains to Dunsmuir.

Ashmead described the galls of this species as "covered with long, brownish wool", which is correct. But the rest of his description of the gall, type galls which I have seen, and gall material labelled *dasydactyli* in several collections, match the galls from which I bred *Heteræcus melanoderma*. The extent of Ashmead's confusion is indicated by his choice of the name *dasydactyli* for this rather than for the true "date-seed" gall, *melanoderma*. The gall and insect both are most nearly related to *H. pacificus*. One might take *pacificus* galls to be older galls of this variety with the wool worn off, but when the wool drops from *dasydactyli* it leaves the gall smooth (unlike *melanoderma*), and showing the projecting base to which the wool was attached (unlike *pacificus*).

### ***Heteræcus dasydactyli* variety *dasydactyli* (Ashmead)**

*Andricus dasydactyli* (adult only!) Ashmead, 1896, Proc. U.S. Nat. Mus., XIX, p. 117. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 62; 1910, Das Tierreich, XXIV, p. 532. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 349. Thompson, 1915, Amer. Ins. Galls, pp. 10, 32. Felt, 1918, N.Y. Mus. Bull., 200, p. 72. Kinsey, 1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 371.

FEMALE.—Differs from the female of other varieties of the species as follows: Parapsidal grooves extending half way or more to the pronotum, finely, not heavily rugose at bottom; median groove very distinct tho short at the scutellum; scutellum of uniform color, not darkened in the foveæ, foveæ wholly but sparingly rugose; first abscissa of the radius arcuate with only a slight suggestion of an angle; length 2.7-3.5 mm., averaging distinctly larger than in any other variety of the species.

GALL.—Differs from the galls of other varieties in being more often long, elongate spindle-shaped, averaging 15-30. mm. long by 7-12. mm. in diameter, often with a long, slender apex, less often curved than in *pygmaeus*; usually singly on the twigs.

RANGE.—California: Yosemite Valley, Placerville, Dunsmuir. Probably occurs in the central Sierras north of El Portal, wherever *Q. chrysolepis* occurs.

TYPES.—Many females, in the U.S. National Museum; labelled number 3063.

Ashmead's adults were bred from January 18 to February 11, probably indoors. I obtained adults at some date after



collecting the galls out-of-doors: March 30 at Placerville, April 3 at Dunsmuir. Galls collected in the Yosemite Valley, at a high elevation, while snow still buried most of the small trees, were quite immature on March 26. These Yosemite Valley insects belong, without doubt, to this variety rather than to *eriphorus*, the variety of the southern Sierras. *Eriophorus* occurs at El Portal, not twelve miles from the Yosemite Valley, but at an elevation which is a thousand feet lower, and in a locality not nearly as exposed to the severe climate of the higher Sierras. The Yosemite Valley belongs to one faunal area, El Portal to another!

### **Heterœcus dasydactyli** variety **eriphorus** (Kieffer)

*Callirhytis eriphora* Kieffer, 1904, Bull. Soc. Metz, (2), XI, p. 132; 1904 (in Baker), Invert. Pacif., I, p. 43. Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 585, 806, 839. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 359. Felt, 1918, N.Y. Mus. Bull., 200, p. 76. Johnson and Ledig, 1918, Pomona Coll. Journ. Ent. and Zool., X, p. 25.

FEMALE.—Differs from the female of other varieties of the species as follows: Parapsidal grooves extending hardly half the length of the mesonotum, almost wholly smooth at bottom; median groove lacking or extremely short; basal foveæ of the scutellum darkened but not black, largely rugose at the bottom, with only small, smooth areas; first abscissa of the radius arcuate, with only a slight suggestion of an angle; length 2.5 mm. (-3.2 mm., acc. Kieffer); averaging distinctly smaller than in variety *dasydactyli*, larger than in *pygmæus*.

GALL.—Very similar to that of variety *pygmæus*. Each gall short, ovoid or less often spindle-shaped, with the tapering point short, not usually curved as in *pygmæus*, more or less smooth. Usually singly, sometimes a few in a cluster, on twigs.

RANGE.—California: El Portal; Claremont (Baker); Upland, Pasadena, San Jacinto Mountains. Probably occurs thruout the southern Sierras and their extensions, south of El Portal, except in the San Bernardino and Cuyamaca mountains.

TYPES.—Berlin Museum? Pomona College? Material from the same collector (Baker) and the same locality (Claremont) at Stanford University.

This variety comes very close to variety *pygmæus*, but the insects can be separated by the darker rufous brown general color, and by the rugose bottoms of the foveæ of *eriphorus*. *Pygmæus* comes from a neighboring but isolated mountain range. I have not seen types of this variety, but Dr. McCracken very kindly compared types of *pygmæus* with Baker

material of *eriophorus* at Stanford University, and independently concluded that the two are distinct. I have insects from Pasadena and the San Jacinto Mountains, but only galls from Upland, which is my locality for the same mountain range from which the Baker material came. All of my material is from *Quercus chrysolepis*. Kieffer records *Q. Wislizenii* as the host. I have never seen such a gall on *Wislizenii*; the only material which I have seen labelled *eriophorus* bore leaves unmistakably those of *chrysolepis*; and I doubt very much whether *Wislizenii* is ever the host for this variety.

### **Heteræcus dasydactyli** variety **pygmæus**, new variety

FEMALE.—Differs from the female of other varieties of the species as follows: Parapsidal grooves extending two-thirds or more of the way to the pronotum, finely, not densely rugose at bottom; median groove distinct for a short distance; basal foveæ of the scutellum darker than in other varieties, occasionally black, almost entirely smooth at bottom; first abscissa of the radius rather sharply angulate, without a projection; length 1.7-2.5 mm., averaging distinctly smaller than in other varieties of the species.

GALL.—Very similar to that of *eriophorus*. Each gall short, ovoid, or more usually spindle-shaped, with the tapering point short and strongly curved; more or less smooth. Singly or up to ten in a compact cluster on the twigs.

RANGE.—California: San Bernardino Mountains; Pasadena (?). Probably confined to the neighborhood of the San Bernardino Mountains.

TYPES.—38 females, 20 clusters of galls. Holotype female, paratype females, and galls in The American Museum of Natural History; paratype females and galls at the Museum of Comparative Zoology, the Philadelphia Academy, Stanford University, the U.S. National Museum, and with the author. Labelled San Bernardino, California; January 31, 1920; Kinsey collector.

The gall of this variety closely resembles that of variety *eriophorus*, but the two can be separated very definitely. Dr. McCracken has compared one of my types with Baker material of *eriophorus*, and she points out distinct differences as noted under *eriophorus*. The San Bernardino Mountains constitute a "mountain island" area with a very distinct geologic history and separated quite definitely from the neighboring San Gabriels, in which latter range Baker collected Kieffer's *eriophorus*. Six insects from Pasadena and their galls match the San Bernardino material closely, tho most of the Pasadena material belongs to *eriophorus*.

**Heterœcus malus**, new species

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color of head and thorax rich brownish rufous, darker only in the foveæ; parapsidal grooves only moderately wide at the scutellum; median groove distinct for a short distance, indicated more or less prominently for the whole mesonotal length; anterior parallel lines indicated less distinctly and rather wider apart than in *bakeri*; basal foveæ of the scutellum darker, only occasionally black, almost as smooth at base as in *bakeri*; abdomen bright brownish rufous, much brighter than in *bakeri*; wing veins moderately dark yellow brown, about as dark as in *bakeri*; areolet very small or lacking; second abscissa of the radius distinctly but not strongly angulate, without a projection, about as in *bakeri*; length 2.0-2.7 mm., averaging smaller than in *bakeri*.

GALL.—Ovoid to almost absolutely spherical, 8.-16. mm., in diameter, only very slightly drawn into a point for attachment basally, and with a very fine, very short point apically 1.0 mm. or much less in length; entirely smooth and naked, or the surface slightly roughened, light to dark green when fresh, tinged with rose red, upon aging becoming brown. Internally more or less solid, with a single larval cell centrally, closely embedded, and between the cell and the base only a discontinuous cavity indicating the usually cylindrical cavity of the species. Singly or in compact clusters of a dozen, more or less, laterally or terminally on twigs of *Quercus chrysolepis*.

RANGE.—California: Pasadena, San Bernardino.

TYPES.—38 females, 21 galls. Holotype female, paratype females, and galls in The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, and with the author. Labelled San Bernardino, California; January 31, 1920; Kinsey collector.

This variety comes near *bakeri*, but is distinct enough. The manner of oviposition, many eggs being laid in a restricted area, is distinct from *bakeri*. Material from the San Bernardino Mountains is remarkably uniform in respect to both the insect and the gall. Material from outside the San Bernardinos, that is, from another faunal area, shows some considerable variation, a part of the Pasadena material fully matching that from the San Bernardinos. I cannot decide whether there are other varieties of this species until I can examine more material. It is not impossible that this should be considered a variety of *H. chrysolepidis*.

**Heterœcus melanoderma**, new species

*Andricus dasydactyli* (gall only!) Ashmead, 1896, Proc. U.S. Nat. Mus., XIX, p. 118. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 62; 1910, Das Tierreich, XXIV, pp. 532, 799, 828. Fulla-

way, 1911, Ann. Ent. Soc. Amer., IV, p. 349. Thompson, 1915, Amer. Insect Galls, pp. 10, 32. Felt, 1918, N.Y. Mus. Bull., 200, p. 72.

**FEMALE.**—Shows the following characters in addition to those common to all species of the genus: Color of head and thorax very dark rufous brown, black in part; parapsidal grooves very broad at the scutellum, pointed anteriorly, hence long-triangular in shape, extending not much more than half way to the pronotum; median groove distinct though short, fairly wide at the scutellum; anterior parallel lines very distinct; scutellum rather finely rugose, basal foveæ of scutellum rugose, broader than in other varieties; mesopleuræ irregularly rugoso-aciculate posteriorly; abdomen rufo-piceous, piceous black dorsally; wing veins only moderately heavy; areolet moderately large; first abscissa of the radius strongly angulate, without a projection; length 3.5-3.7 mm., the whole build distinctly larger than in any other variety.

**GALL.**—Elongate, scurfy, like a date seed in shape. Cylindrical, averaging 6. mm. wide by 20. mm. long, bluntly, short, and conically pointed apically, slightly tapered basally, broadest near the apex; covered with a dense, very short, scurfy pubescence, rich golden brown, weathering dull brown to black. Monothalamous. Internally with a single, cylindrical, central cavity 2. mm. wide extending from the base almost to the tip of the gall; a larval cell, 1.7 x 3.5 mm., lies in the cavity, usually nearer the apical end. Sessile, on twigs of *Quercus chrysolepis*.

**RANGE.**—California: Cupertino (Fullaway); Los Gatos (McCracken coll.); Redwood Park (in Stanford Univ. coll.); Boulder Creek, Placerville.

**TYPES.**—2 females, 7 galls. Holotype female, paratype galls in The American Museum of Natural History; paratype female and galls with the author; paratype galls at Stanford University and the U.S. National Museum. Labelled Placerville, California; March 30, 1920; Kinsey collector.

Adults were almost mature in the galls at Placerville, March 30, and emerged some time later.

Material of this species in several museums is labelled *Andricus dasydactyli*, and this gall largely agrees with the gall described for that species by Ashmead. But the insect *dasydactyli* comes from galls covered with long wool, and is very distinct from *melanoderma* adults; the latter species has been heretofore undescribed. Weld sends me galls from the Santa Catalina Mountains of Arizona, occurring on *Quercus oblongifolia*; the galls are similar to those of *melanoderma*, but I have not yet seen the insects.

### **Heterœcus pacificus (Ashmead)**

**FEMALE.**—Shows the following characters in addition to those common to all species of the genus: Color of head and thorax rich



brownish rufous; parapsidal grooves very broad at the scutellum, pointed anteriorly, hence long-triangulate in shape, in two varieties more rugose at bottom than in *dasydactyli*, extending not much more than half way to the pronotum; median groove very short or lacking, often wide at the scutellum; anterior parallel lines fine but more evident, rather finely rugose; scutellum dark to black in the foveæ, foveæ rugose at base; abdomen darker rufous, rufo-piceous in part; wing-veins brown, darker than in *melanoderma* or *dasydactyli*; the areolet of moderate size or large; first abscissa of the radius arcuate-angular, with a more distinct angle than in *dasydactyli*; length 2.8-3.7 mm.

GALL.—Naked, elongate, spindle-shaped. Cylindrical, with a constricted base and a greatly elongate, slender tip; entirely straight or curved; entirely naked, smooth, bright green splotted with brown to purple brown, becoming dark brown upon aging. Solid, except for the cylindrical cavity extending from the base two-thirds to the tip, the larval cell not always at the very end of the cavity. On twigs of *Quercus chrysolepis*.

RANGE.—California: San Jacinto Mountains to Dunsmuir and Ukiah; probably wherever *Q. chrysolepis* occurs.

This species morphologically is closely related to *dasydactyli*, but altho Ashmead stated that the insects of *pacificus* "cannot be separated from *A. dasydactyli*", his types of the two are distinct, showing differences which agree with those in the material I have bred from the two types of galls. *Pacificus* never bears any of the woolly covering which is characteristic of *dasydactyli*.

Adult insects emerge in the spring, a couple of months earlier in southern than in northern California.

### ***Heterœcus pacificus* variety *pacificus* (Ashmead)**

*Andricus pacificus* Ashmead, 1896, Proc. U.S. Nat. Mus., XIX, p. 118.

Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 64; 1910, Das Tierreich, XXIV, pp. 532, 805, 828. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 348. Thompson, 1915, Amer. Ins. Galls, pp. 9, 33. Felt, 1918, N.Y. Mus. Bull., 200, p. 68.

FEMALE.—Differs from other varieties of the species as follows: Parapsidal grooves rugose at bottom; median groove short or lacking; wing veins somewhat heavier than in the other varieties; areolet quite large, about equilateral; length 3.2-3.7 mm., larger and heavier than in other varieties.

GALL.—Differs from the galls of other varieties in averaging larger, longer, more slender, the tip about as in *subpacificus*, shorter than in *gracilis*.

RANGE.—California: Cupertino (Fullaway); Placerville, Auburn, Dunsmuir. Probably thruout the central Sierras, from El Portal north, wherever *Q. chrysolepis* occurs.

TYPES.—Adults and galls, in the U.S. National Museum; labelled 3064.

The redescription of adults and galls is made from a considerable quantity of material in my collection, compared with types.

The insects from Auburn and Dunsmuir material agree entirely with those from Placerville. I collected galls from March 26 to April 3; the adults emerged at some later date.

***Heteræcus pacificus* variety *subpacificus*, new variety**

*Cynipide*, 38, Trotter, 1910, Boll. Lab. Portici, V, p. 114, pl. 1, figs. 22-23.

FEMALE.—Differs from the female of the other varieties of the species only as follows: Parapsidal grooves rugose at bottom; median groove short or lacking; wing veins somewhat finer than in variety *pacificus*; areolet of only moderate size, about equilateral; first abscissa of the radius more arcuate than in either other variety; length 3.0-3.2 mm., distinctly smaller than in variety *pacificus*.

GALL.—Very similar to the galls of other varieties of the species, differing in averaging much shorter, but of as great diameter as in variety *pacificus*, hence more robust; the tip is about as long as in *pacificus*, often curved, even at right angles with the body of the gall.

RANGE.—California: Yosemite (Trotter); El Portal, San Jacinto Mountains. Probably thruout the southern Sierras and their extensions, from El Portal south, except in the San Bernardino and Cuyamaca ranges.

TYPES.—5 females, 40 galls. Holotype female and paratype galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, and with the author. Labelled El Portal, California; March 26, 1920; Kinsey collector.

The insects had mostly emerged in the San Jacinto mountains by February 28. Further north at El Portal a larger proportion of the insects had not yet emerged on March 26. Thus do emergence dates vary with the development of the season.

This variety comes very close to variety *pacificus*, but does show differences in the insect morphology, the galls, and the range. San Jacinto material agrees distinctly with the El Portal material; altho the two localities are about three hundred and fifty miles apart they are in the same faunal area.

***Heteræcus pacificus* variety *gracilis*, new variety**

FEMALE.—Differs from other varieties of the species as follows: Generally of a darker, richer rufous brown; parapsidal grooves almost entirely smooth at bottom; median groove often longer, very wide at

the scutellum; wing veins somewhat finer than in variety *pacificus*; areolet of moderate size or larger, distinctly elongate on the cubitus; length 2.8-3.2 mm.

GALL.—Very similar to the galls of other varieties of the species, differing in averaging smaller, tho individual galls will equal those of the other varieties in size; more slender, with a longer, more slender point.

RANGE.—California: Ukiah. Probably confined to a part of Mendocino and northern Sonoma Counties.

TYPES.—6 females, 23 galls. Holotype female, paratype galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, and with the author; paratype galls at the Museum of Comparative Zoology, and the Philadelphia Academy. Labelled Ukiah, California; March 17, 1920; Kinsey collector.

Galls were found in several stages of development at Ukiah on March 17; the insects emerged at some later date.

Both the insects and galls of this variety are more distinct than those of other varieties of the species.

### *Heteroecus sanctæ-clarae* (Fullaway)

FEMALE.—Differs from the females of other species of the genus as follows: Color of head and thorax mostly rich, dark, brownish rufous, blackish in part; parapsidal grooves distinct, moderately wide at the scutellum, rugose at bottom, extending only half the mesonotal length; median groove indicated by a rather wide depression for a short distance from the scutellum; anterior parallel lines fine, distinct; scutellum rather deeply rugose, the basal foveæ smooth or rugose at bottom; mesopleuræ with a small dorsal area rugoso-punctate; abdomen darker or lighter rufous, second segment covering not more than three quarters the whole area; wing veins rich brown or yellowish brown; margins short ciliate; areolet of moderate size or larger; second abscissa of the radius almost straight; first abscissa arcuate-angulate; length 2.5-3.5 mm.

GALL.—A smooth, two-parted gall. The lower portion of the gall is rather cylindrical, narrower apically where it is inserted into the second part, concave basally where it is attached to the twig; the upper portion is low, cylindrical, as wide or more often nearer twice as wide as the lower portion, as high or little higher than the lower portion, drawn more or less abruptly into a long, rather slender, blunt point; gall measuring up to 15. mm. in greatest diameter, and 20. mm. in total length; externally smooth or slightly roughened, covered with a bluish white bloom when fresh, becoming light buff to golden yellow, blackening on weathering. Internally compact, not woody, solid except for a small, irregular cavity in the upper portion; the larval cell about central, divided between the two parts of the gall, or nearer the base. Sessile on twigs of *Quercus chrysolepis*.

RANGE.—California: San Jacinto Mountains to Dunsmuir.

This is not an acorn gall, as stated in the original description, but a bud gall. The insect shows extremely close relationships to other species of the genus. Indeed, the distinctive characters of the species are few. These characters are not as marked as for most varieties of species of the genus, and but for the character of the gall, *sanctæ-claræ* would never have been described when it was. In regard to the gall, the character of the external surface, the compact internal tissues, and the fact that it is a monothalamous bud gall would indicate even a physiology related to that of the other species. It is in general form only that the galls are distinct.

As usual, the varieties are distributed in distinct faunal areas.

### ***Heteræcus sanctæ-claræ* variety *sanctæ-claræ* (Fullaway)**

*Callirhytis sanctæ-claræ* Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 363, fig. 5. Felt, 1918, N.Y. Mus. Bull., 200, p. 118.

? *Disholcaspis* sp. Trotter, 1910, Boll. Lab. Portici, V, p. 109, fig. 9.

**FEMALE.**—Differs from the other varieties of the species as follows: Antennæ almost wholly brownish rufous, hardly lighter basally; thorax almost wholly rich, dark, brownish rufous, blackish on the anterior parallel and lateral lines; depression at base of scutellum almost smooth at bottom for a wide area; most of mesopleuræ heavily puncto-aciculate, almost entirely brown rufous, only finely edged blackish, abdomen rufous, darker dorsally, yellow rufous ventro-posteriorly; second segment covering about two-thirds of the abdominal area; wing veins rich brown, areolet moderately large, larger than in the other varieties; first abscissa of the radius limitedly infuscated; length 3.0-3.5 mm.

**GALL.**—Does not differ particularly from the galls of the other varieties.

**RANGE.**—California: Cupertino (Fullaway); Yosemite (Trotter); South Fork of Kings River, Tulare Co. (Weld); Boulder Creek, Dunsmuir, Placerville. Probably confined to the more northern parts of California, where *Q. chrysolepis* occurs.

**TYPES.**—2 females, 1 gall, at Stanford University; collected at Stevens Creek Canyon, above Cupertino, California, by R. W. Patterson.

I have seen the types of this species, but the above description was made from material I collected at Boulder Creek. I have not seen the insects of the Yosemite and Kings River material, so refer the galls to this variety rather than to the other only because of the geographic distribution. Insects had emerged from galls collected in March and April; dead adults were obtained by cutting into the galls.



**Heterœcus sanctæ-clarae variety fuscior new variety**

**FEMALE.**—Differs from the other varieties of the species as follows: Antennæ distinctly light yellow rufous basally; thorax rich, dark, brownish rufous, distinctly black on the anterior parallel and lateral lines in the basal depression of the scutellum; depression at base of scutellum more rugose at bottom; most of mesopleuræ finely and more regularly puncto-aciculate, very distinctly edged with black; abdomen dark rufo-piceous, almost black dorsally, yellow-rufous ventro-posteriorly; second segment covering more than three quarters the abdominal area; wing veins light yellowish brown; areolet of moderate size, smaller than in the other varieties; first abscissa of the radius not infuscated; length 2.5-2.7 mm.

**GALL.**—Does not differ particularly from the galls of the other varieties.

**RANGE.**—San Jacinto Mountains, Pasadena. Probably thruout the southern Sierras and their extensions, except in the San Bernardino and Cuyamaca ranges.

**TYPES.**—2 females and 16 galls. Holotype female, paratype galls in The American Museum of Natural History; paratype female and galls with the author; paratype galls at Stanford University, the Museum of Comparative Zoology, and the U.S. National Museum. Labelled San Jacinto Mountains, California; February 28, 1920; Kinsey collector.

The insects had all emerged before the collecting in January and February.

**Heterœcus sanctæ-clarae variety aliud, new variety**

**FEMALE.**—Differs from the other varieties of the species as follows: Thorax rich, dark, rufous brown, distinctly black on the anterior parallel and lateral lines, in the basal foveæ of the scutellum, and on the edges of the mesopleuræ; depression at base of scutellum distinctly smooth at the bottom; most of mesopleuræ finely and more regularly puncto-aciculate, similar in this regard to *fuscior*, more heavily edged with black, especially ventrally, than in *fuscior*; abdomen dark rufo-piceous, almost black dorsally, dark brownish rufous ventro-posteriorly; second segment covering about two thirds of the abdominal area, about as in variety *sanctæ-clarae* rather than in *fuscior*; wings with veins light brown, darker than in *fuscior*, distinctly lighter than in *sanctæ-clarae*; areolet of moderate size, rather larger than in *fuscior*; first abscissa of the radius with an indication of a limited infuscation, less so than in *sanctæ-clarae*; length 2.7 mm., intermediate in size and build between the other two varieties.

**GALL.**—Does not differ particularly from the galls of the other varieties. On *Quercus chrysolepis*.

**RANGE.**—San Bernardino Mountains. Probably confined to this range.

**TYPES.**—1 female, 7 galls. Holotype female, paratype galls in The American Museum of Natural History; paratype galls at Stanford University, the U.S. National Museum, and with the author. Labelled San Bernardino, California; January 31, 1920; Kinsey collector.

Adults had all emerged before January 31, tho the galls still possessed a bloom, probably indicating that the insects had emerged not long previously.

This variety again illustrates the remarkably distinct nature of the fauna of the San Bernardinos. There is not the least difficulty in separating this variety from either of the others, but if one will compare the descriptions of the adults word for word he will be struck by the fact that part of the characters of this variety match those of variety *sanctæ-clarae*, and part those of *fuscior*. On a whole the variety comes nearer *fuscior*.

### ***Neuroterus cupulæ*, new species**

**FEMALE.**—Almost wholly black, a light ring at base of the third segment of the antennæ; mesopleuræ finely coriaceous; areolet large; length up to 1.7 mm. **HEAD:** As wide as the thorax, moderately widened behind the eyes; black, mouthparts deep rufous brown; very finely and evenly shagreened, smoother on the face, face scatteringly punctate and pubescent. Antennæ short, black, piceous black basally, apex of the second segment and base of the third usually yellow piceous; with 13 segments, the last segment hardly longer than the preceding. **THORAX:** Entirely black; mesonotum practically smooth, shining, and naked, very faintly and microscopically shagreened; entirely without grooves; scutellum large, oval, smooth, and shining, very faintly and microscopically shagreened, an arcuate furrow at the base; pronotum very finely, irregularly puncto-shagreened at the sides; mesopleuræ shagreened-coriaceous. **ABDOMEN:** Piceous black; entirely smooth and shining, and practically naked; large, irregularly triangular, protruding ventrally as far as or further than dorsally; the second segment occupying about half the area; ventral valves at a 60° angle to almost vertical. **LEGS:** Piceous black, brownish yellow on the joints and on the tarsi, the tips of the tarsi dark; finely pubescent; tarsal claws simple. **WINGS:** Clear, set with fine hairs, anterior margins scarcely ciliate; veins rich brown; areolet large to very large; cubitus reaches the basalis below the mid-point, distinct for the whole length; radial cell open, second abscissa of the radius somewhat curved, most so toward the tip, not quite reaching the margin of the wing; first abscissa sharply angulate. **LENGTH:** 1.0-1.7 mm.

**GALL.**—Only a larval cell buried in the wood of the acorn cup. The cell oval, averaging 1.5 mm. wide by 2.2 mm. long; the walls hard but not thick; entirely hollow. Buried wholly or in part in the wood of the acorn cup, oftenest at the base; part of the cell sometimes visible within

the cup, only rarely producing a slight swelling on the outside of the cup. On *Quercus lobata*.

RANGE.—California: Paso Robles, Gilroy (Redwood School).

TYPES.—50 females and many infested acorns; holotype female, paratype females, and galls in The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Paso Robles, California, March 7, 1920, Kinsey collector.

Adults were emerging at Paso Robles on March 7, after most of the cupules had fallen to the ground. This is clearly an agamic generation, and very probably has an alternate, bisexual generation, probably not occurring on acorn cups. A similar gall occurs on *Q. garryana* on the north Pacific Coast; the insects will probably prove to belong to a distinct variety.

### ***Neuroterus evanescens*, new species**

Almost wholly black, straw colored on the antennæ and parts of the legs; areolet moderately large; length 1.0 mm. or less.

FEMALE.—HEAD: As broad or broader than the thorax, protruding slightly behind the eyes; wholly black except the straw yellowish mouth-parts; apparently smooth, but microscopically coriaceous, most so toward the mouth. Antennæ light straw yellow; very finely pubescent; with 13 segments, the third the longest but not much longer than the fourth, the last about as long as the preceding. THORAX: Entirely black or piceous black; mesonotum almost entirely smooth, shining, without lines or grooves; scutellum almost smooth, shining, with a very few hairs, the groove at the base only slightly arcuate; pronotum piceous black, very finely roughened; mesopleuræ piceous black, very finely rugoso-aciculate. ABDOMEN: Piceous black or black; smooth, naked; small, about triangular, shrivelling, extending ventrally as far as or further than dorsally. LEGS: Dark brown, light straw brown at the joints and on the tarsi, the tips of the tarsi darker; very finely hairy; tarsal claws simple. WINGS: Very clear, edges ciliate; veins straw brown, distinct; areolet of moderate size; cubitus reaches the basalis; radial cell entirely open, not as long and narrow as usually in the genus; second abscissa of the radius practically straight; first abscissa distinctly angulate but without a projecting tip. LENGTH: 0.7-1.0 mm.

MALE.—Similar to the female, but with 14 segments to the antennæ; legs almost wholly straw brown; abdomen much smaller, with a more distinct but not long pedicel.

GALL.—Very slight swelling of the stem of the ament, causing an abortion of the whole ament into a short, ovoid mass about 5. mm. long, covered closely with clustered but otherwise normal anthers. The larval cells are tiny cavities in the swollen stem, without distinct linings, covered on the outside by only very thin tissue. On aments of *Quercus breviloba*.

RANGE.—Texas: Austin (Patterson).

TYPES.—31 females, 2 males, 3 galls. Holotype female, paratype females, male, and gall in The American Museum of Natural History; paratype adults and galls with the author; paratype females in the U.S. National Museum, the Museum of Comparative Zoology, and the Philadelphia Academy. Labelled Austin, Texas, *Q. breviloba*, Patterson collection number 46.

Only two males were obtained among the fourteen adults, but it is not unlikely that the sexes are usually more nearly equal in number. Patterson reports the galls appearing early in March, and the adults beginning to emerge March 15. With such a short life history for this generation, another form must occur in the remainder of the year. A bisexual generation on such an evanescent part of the host usually produces the alternate, agamic generation on some other part of the same host, and Patterson has observed the females ovipositing on the under sides of the leaves. The gall material of the Patterson collection number 68 occurs on *Q. stellata*; it shows only a slightly greater degree of swelling of the stems, but when the insects are obtained it may prove a distinct variety confined to the single species of host.

### ***Neuroterus floricola*, new species**

FEMALE.—Generally piceous, legs brownish and piceous; areolet very small; length 1.0 mm. or slightly more. HEAD: Not as wide as the thorax, not widened behind the eyes; black, the mouthparts yellow with some piceous; very finely roughened, practically naked. Antennæ brownish black, hardly lighter basally, the second segment globose, the third hardly longer than the fourth. THORAX: Piceous black, very finely roughened, almost finely coriaceous; parapsidal and median grooves lacking, anterior parallel and lateral lines barely indicated as smoother, slightly raised lines; scutellum about circular, with an arcuate depression basally; mesopleuræ not wholly smooth. ABDOMEN: Piceous black; smooth, naked; somewhat triangulate, produced dorsally about as far as or somewhat farther than ventrally; ventral spine very short, fine. LEGS: Brownish, the femora and hind tibiæ piceous; tarsal claws fine, simple. WINGS: Very long; clear; finely ciliate on the margins; veins brown, mostly rather fine; areolet very small; radial cell long and narrow, open, the second abscissa of the radius slightly curved; the first abscissa distinctly angulate but without a projection. LENGTH: 1.0-1.3 mm.

MALE.—Differs from the female as follows: Head golden yellow, front brownish; antennæ yellow basally; whole thorax light brownish; abdomen brown, small, pedicellate; legs entirely golden yellow; areolet rather small, but larger than in the female.



GALL.—A minute, egg-shaped capsule in the aments. Monothalamous. Each capsule ovate, somewhat elongate, more pointed apically; golden yellow brown, the surface finely pitted like leather; averaging 1.5 mm. long by 0.7 mm. wide; thin-walled, entirely hollow. Singly or two or three completely fused; showing clearly the origin from the anthers, sometimes incompletely furrowed, or with parts of anthers attached; on the aments of *Quercus Douglasii*.

RANGE.—California: Three Rivers. Probably occurs thruout the range of *Quercus Douglasii*.

TYPES.—10 females, 3 males, 27 clusters of galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, and with the author. Labelled Three Rivers, California; March 23, 1920; *Q. Douglasii*; Kinsey collector.

A form on the flowers of the oak must have a short life history, with an alternate, probably agamic generation.

This tiny species is of especial interest because the gall so closely resembles that of *Andricus gigas* Kinsey, *gigas* galls differing mainly in being larger, averaging 2.0 mm. in length by 1.0 mm. wide. *Gigas* was obtained from the same oak, in the same faunal area. I also have *gigas* from the same flowers which gave this *Neuroterus*. Of course the two insects are very distinct, belonging to different genera, even if the name *Andricus* does not define a genus. Some other species of Cynipidæ produce similar galls on the aments. Here is one of the few cases I know among cynipids producing distinct galls where the species and genus of the gall maker is not the primary factor in determining the type of the gall. The anther appears to have only certain possibilities for abnormal development; practically identical results are effected when the stimulus is supplied by either *Andricus gigas* or *Neuroterus floricola*. Galls of much the same type, altho clustered differently and of several different shapes, are effected by *Andricus dubiosus* (Fullaway), *Andricus serri-cornis* Kinsey, *Neuroterus pallidus* Bassett, and some other species. In fact, I do not now recall any species where any other sort of modification of the anther is produced. The diversity of these insects is great; it would appear to be the nature of the anther which restricts the type of modification.

### Plagiotrichus Mayr

*Plagiotrichus* Mayr, 1881, Gen. Gallenbw. Cynip., pp. 8, 12, 32. Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, p. 388.

**FEMALE.**—Head enlarged behind the eyes; antennæ with 14 or 15 segments; mesonotum never wholly smooth, often puncto-rugose, hairy; foveæ present; tarsal claws simple; anterior margins of wings not ciliate; radial area open. **HEAD:** About as wide as the thorax, considerably enlarged behind the eyes in the agamic female, usually by a distance equalling the width of the eyes; slightly enlarged behind the eyes in the bisexual form; malar space about one third the length of the compound eyes in the agamic female, less in the bisexual forms, especially the males; face without aciculations; no malar furrow; more or less finely puncto-rugose, largely hairy, most hairy and rugose on the face; rufus to black, the tips of the mandibles piceous. Antennæ golden rufous to black, often the seven or eight terminal segments darker; only finely pubescent, usually rather long, usually not much enlarged terminally; with 14 or 15 (or rarely 16) segments, the second the shortest segment but distinctly elongate, the third only somewhat longer than the fourth, the last hardly longer than the preceding, sometimes longer and with another division. **THORAX:** Mesonotum mostly finely punctate, puncto-shagreened to puncto-rugose, never roughly rugose, naked or more usually largely hairy; parapsidal grooves often fine, shallow, often discontinuous, indistinct, or faintest anteriorly, gradually converging posteriorly; median groove more or less faint or reduced, or lacking; anterior parallel lines lacking or in part indistinct or distinct; lateral lines smooth; scutellum longer than wide, moderately rounded posteriorly, coriaceous to rugose, hairy; foveæ always present, more or less distinctly separated; pronotum laterally striate rugose; mesopleuræ in part smooth, shining, and naked, in part punctate, puncto-rugose or rugose aciculate, often hairy. **ABDOMEN:** Mostly smooth and naked, sometimes sparsely hairy, sometimes finely punctate or reticulate, somewhat shorter to slightly longer than high, not produced dorsally, the second segment covering less than a half to two-thirds of the area, its edge more or less slightly oblique and much rounded ventrally; ventral spine not long, slender; ventral valves toward the vertical. **LEGS:** Brownish rufous, in part darker especially on the hind tibiæ, entirely golden yellow in the bisexual forms; tarsal claws rather fine, simple. **WINGS:** Entirely clear, pubescent, the anterior margins not ciliate or short ciliate; veins brown, only the subcosta and cross veins ever heavy; areolet very small to very large; cubitus continuous or discontinuous; radial cell open, rather long, the second abscissa of the radius moderately curved; the first abscissa distinctly, sometimes sharply, angulate, with or without, usually without a projection, sometimes very limitedly infuscated. **LENGTH:** 1.2-3.5 mm.

**GALL.**—A more or less gradual, woody swelling, on stems, leaves, or flowers. Polythalamous, varying from a very few to a great many cells in a gall. The swelling usually elongate, less often globose, usually arising gradually, surrounding and involving the affected parts; covered with normal epidermis mostly of normal color and texture. Internally woody, the tissue increased but not otherwise greatly modified, the larval cells with only a more or less distinct lining, in some cases solidly imbedded, sometimes with the cells in a more or less continuous cavity in the wood, each cell distinct, adjoining the next, but inseparable; some-

times the larval cell entirely separable at maturity. On both black and white oaks, the agamic generation in larger, more woody stem galls, and the bisexual generation in smaller galls on veins, petioles, flower stems.

RANGE.—Western Asia, Europe, northern Africa, and North America. Probably wherever oaks occur.

TYPE.—*Cynips ilicis* Fabricius. Designated by Ashmead, 1903, Psyche, X, p. 151.

This description largely agrees with the Das Tierreich description, and is somewhat broadened to include both European and American species showing close relationships. I have specimens of *P. ilicis* and some other European species kindly sent me by Prof. A. Trotter, of Portici, Italy, and have compared all other species with *ilicis*. This genus has not been recognized in the North American fauna previously. It is known from western Asia, Europe, and northern Africa from only three or possibly four species. The insects are characterized by the key characters at the beginning of this description. The genus as I recognize it is a very compact group of species, distinguished by insect morphology, very uniform gall characters, and probably uniform life histories. Here is a good instance of the correlation of morphologic and physiologic characters. I repeat that I question the quality of any "genus" where the two sorts of characters are not correlated! All of the American species previously described have been placed in the heterogeneous mixtures called *Andricus* or *Callirhytis*. *Plagiotrichus* is closely related to *Dryocosmus* Giraud, but the two groups should not be united. *Dryocosmus* shows some specialization in structure, particularly of the abdomen, and the galls are more highly specialized, being aggregations of monothalamous stem galls. *Plagiotrichus* is distinctly a more primitive group, probably "ancestral" to *Dryocosmus* and to a group including some of the other North American stem gall producers not yet assigned to exact genera.

The relatively smaller second abdominal segment, the simple tarsal claws, the simple nature of the galls (polythalamous, inseparable, without special structures, the larval cell often inseparable), and the fundamental similarity of the alternate generations are the primitive characters. The open radial cell, the reduced thoracic sculpture, and the occurrence of heterogeny mark some degree of specialization, greater than occurs in the genus *Neuroterus*, for instance.

Kieffer states in *Das Tierreich* that *Plagiotrichus kiefferianus* is the agamic generation of *P. ilicis*. I have not seen a further account of this life history, and I do not know of any other life history being proved in the genus. But this alternation is entirely probable because the galls of the two generations are fundamentally alike, differing only in connection with their occurrence on different parts of the hosts, and the bisexual and agamic insects clearly belong to the same genus. All of our American bisexual species occur in galls which are typical of *ilicis*, and all of our agamic species occur in galls similar to *kiefferianus*. Probably both generations have been described as separate species for some of our eastern American insects of this genus. On the Pacific Coast apparently only one bisexual form, *P. congregatus*, is described, altho I have the galls of several forms which very probably alternate with varieties of *P. chrysolepidicola*, *P. suttonii*, *P. perdens*, or *P. asymmetricus*. Several of these undescribed galls are leaf vein swellings little different from *ilicis* galls. Some are more woody petiole swellings.

A fact to be emphasized is the close similarity of the two generations, except that one is agamic and the other bisexual. My detailed description of the insects and galls fits both the bisexual and agamic forms of all the species yet known. Again we find that alternation of generations is only an extreme development of seasonal dimorphism.

In addition to the species treated in this paper, the following American Cynipidæ should be assigned to *Plagiotrichus*:

*Plagiotrichus concolorans* (Kinsey) (= *P. cicatriculus* (Bassett) ?). Agamic; eastern; white oaks.

*P. congregatus* (Ashmead). Described from female only; both sexes among the types; Pacific Coast; on white oaks.

*P. cornigerus* (Osten Sacken). Agamic; eastern; on black oaks.

*P. punctatus* (Bassett). Agamic; eastern; on black oaks.

*P. quinqueseptum* (Ashmead). Agamic; eastern; white oaks.

*P. reticulatus* (Bassett). Only female described; southwestern; white oaks.

*P. scitulus* (Bassett). Bisexual; eastern; on black oaks.

*P. tumificus* (Osten Sacken). Bisexual; eastern; on black oaks.



I shall withhold opinion on the generic position of some other American Cynipidæ from stem and leaf vein galls until further revision of cynipid genera may indicate the several trends of evolution.

With many if not all of the species of this genus, each variety is confined to a single oak. The influences of host isolation have been greater than with some other Cynipidæ, and with some of the insects of the genus host isolation has succeeded in developing more distinct varieties than geographic isolation has effected.

### ***Plagiotrichus asymmetricus*, new species**

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color light rufous brown and darker to black; widened but not greatly so behind the eyes; antennæ brown, first four or five segments lighter, with 14 segments; mesonotum more or less smooth and shining, but coriaceous in places, more or less distinct, rugous striæ radiating from the midpoint of the posterior margin, anteriorly more coriaceous or rugose; the thorax naked of hairs; parapsidal grooves never traceable for more than a short distance from the scutellum, converging considerably posteriorly; median groove and anterior parallel lines barely indicated as marks, not as grooves or lines; lateral lines short, oval depressions; a smooth, arcuate foveal furrow hardly divided into two by a very fine, median ridge; mesopleuræ brownish rufous or darker, at least in part aciculate; abdomen rich rufous brown or darker, entirely smooth, shining, neither punctate nor reticulate, about as high as long, the second segment occupying hardly half the area; legs largely rufous, hind tibiæ darker centrally; areolet of moderate size to very large; cubitus not reaching the basalis; length 1.7-3.0 mm.

GALL.—Stem swelling containing compact clusters of larval cells. Polythalamous. The swelling covered with bark normal in appearance; a gradual enlargement, often asymmetrical on the stem; up to 30. mm. long, by 20. mm. broad. Internally, the larval cells in compact masses, each cell with a distinct and sometimes separable lining, not very thin walled; the cells usually densely clustered. On young stems of *Quercus chrysolepis*.

RANGE.—California: Pasadena and San Bernardino to Dunsmuir and Ukiah. Probably wherever *Q. chrysolepis* occurs.

The gall of this species does not differ materially in external appearance from the galls of two other Pacific Coast species found on the same host: *Andricus spectabilis* Kinsey and *Plagiotrichus chrysolepidicola* (Ashmead).

The species presents the typical condition of distinct varieties wherever it occurs in a distinct faunal area. Between

the adults of the first two varieties there are few differences, but their galls are very distinctive; between the galls of the second and third varieties there are not appreciable differences, but their adults are very distinct. In the first instance the species varies more physiologically than morphologically, in the second instance the morphology varies more than does the physiology.

**Plagiotrichus asymmetricus** variety **asymmetricus**, new variety

FEMALE.—Closely resembles the female of the following variety; head light rufous brown, rather coarsely coriaceous, distinctly rugose on the face; antennæ dark brown, yellow rufous basally; mesonotum brownish yellow or light rufous brown, in part dark brown to black, usually dark brown lateral to the parapsidal grooves; mesonotum smoothed and shining, but distinctly uneven and irregularly coriaceous in places, distinct striæ radiating from the midpoint of the posterior margin, anteriorly much more coriaceous or even rugose antero-laterally; parapsidal grooves, median, anterior parallel, and lateral lines more distinct than in *compactus*; scutellum yellow rufous or darker, almost black on the edges, finely rugose but not as finely as in *compactus*; arcuate furrow at base of scutellum rather wide, the division into foveæ hardly evident; pronotum rich rufous, brown black on the edges; mesopleuræ wholly, unevenly coriaceous to aciculate; abdomen rich rufous brown, spotted with brown black; wing veins rather heavy, dark brown; areolet large to very large; length 1.7-2.3 mm.

GALL.—A stem swelling, differing from that of both other varieties in being more asymmetrical, about 20. mm. long by 7. mm. wide, with the larval cells mostly between the modified bark and the wood. On stems of *Quercus chrysolepis*.

RANGE.—California: Ukiah. Probably confined to a limited area in the region of Mendocino and northern Sonoma counties.

TYPES.—14 females, 2 galls. Holotype female, paratype females, and gall in The American Museum of Natural History; paratype females and gall with the author; paratype females at Stanford University and the U.S. National Museum. Labelled Ukiah, California; March 17, 1920; Kinsey collector.

All of the type females were cut from the galls, failing to emerge probably because the galls were collected too early (March 17).

The gall of this variety is rather distinct from that of the other varieties; the insects closely resemble those of variety *annectens*.

**Plagiotrichus asymmetricus** variety **annectens**, new variety

FEMALE.—Almost identical with the female of variety *asymmetricus* (q. v.), differing as follows: Generally of darker color; scutel-

lum somewhat more elongate, basal furrow rather wider; length 2.5-3.0 mm.

GALL.—Differs from the gall of variety *asymmetricus* in having almost the entire swelling compactly filled with larval cells, the swelling more symmetrical; observed up to 3.0 mm. long, probably often longer; the outer bark often splits and in part breaks away. On stems of *Quercus chrysolepis*.

RANGE.—California: Placerville, Dunsmuir. Probably confined to the central Sierras, north of El Portal, at the elevations at which *Q. chrysolepis* occurs.

TYPES.—8 females, 7 galls. Holotype female, paratype female; and galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, and with the author. Labelled Placerville, California; March 30, 1920; Kinsey collector.

Insects emerged from these galls sometime after the date of collecting at Placerville, March 30.

The adults do not appear to differ from variety *asymmetricus* except in color and size characters. But inasmuch as the galls of the two are distinct, and the varieties occur in distinct tho related faunal areas we are warranted in recognizing the differences.

### **Plagiotrichus asymmetricus variety compactus, new variety**

FEMALE.—Differs from the female of the other two varieties as follows: Head still lighter brownish rufous, more finely sculptured; areolet of moderate size, much smaller than in the other two varieties; antennæ light yellow brown, more yellow basally; thorax almost wholly clear brownish rufous; mesonotum very largely smooth and shining, faintly coriaceous anteriorly, with very faint striæ from the midpoint of the posterior margin; parapsidal grooves, median, anterior parallel, and lateral lines hardly at all indicated; scutellum wholly rufous brown, more finely rugose than in other varieties; the arcuate furrow at the base of the scutellum more nearly divided into two than in other varieties; pronotum wholly rufous brown; mesopleuræ largely smooth and shining, in only a small part aciculate; abdomen dark brown or brown black; wing veins of moderate weight, light brown; areolet of moderate size only; length 1.7-2.0 mm., smaller than in other varieties.

GALL.—Practically identical with that of variety *annectens*. On stems of *Quercus chrysolepis*.

RANGE.—California: El Portal, Pasadena. Probably occurs thruout the southern Sierras, from El Portal to the Sierra Madre and San Jacinto mountains, except in the San Bernardino range.

TYPES.—8 females, 14 galls. Holotype female, paratype female, and galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, and with the author.

The adult of this variety is remarkably distinct, considering how similar the insects of the other two varieties are. The gall, however, is quite like that of *annectens*. It is often broken into, apparently by birds or mice in search of the cluster of larvæ, for food. Most of the insects had emerged before collection on March 26 at El Portal.

### **Plagiotrichus batatoides (Ashmead)**

- [gall only] Osten Sacken, 1862, Proc. Ent. Soc. Phila., I, p. 259.  
*Cynips q. batatoides* Ashmead, 1881, Trans. Amer. Ent. Soc., IX, p. XI.  
*Cynips batatoides* Packard, 1881, U.S. Ent. Comm. Bull., VII, p. 57.  
*Andricus batatoides* Ashmead, 1885, Trans. Amer. Ent. Soc., XII, p. 295;  
1887, Trans. Amer. Ent. Soc., XIV, p. 132. Ashmead (in Packard),  
1890, 5th Rpt. U.S. Ent. Comm., p. 106. Dalla Torre, 1893, Cat.  
Hymen. Cynip., II, p. 80. Dalla Torre and Kieffer, 1902, Gen. Ins.  
Hymen. Cynip., p. 61. Beutenmuller, 1904, Bull. Amer. Mus. Nat.  
Hist., XX, p. 24. Thompson, 1915, Amer. Ins. Galls, pp. 6, 31. Felt,  
1916, N.Y. Mus. Bull., 186, p. 93; 1918, N.Y. Mus. Bull., 200, p. 58.  
*Callirhytis batatoides* Mayr, 1902, Verh. Ges. Wein, LII, p. 289. Beuten-  
muller (in Dozier), 1920, Ann. Ent. Soc. Amer., XIII, p. 373.  
*Callirhytis quercus-batatoides* Dalla Torre and Kieffer, 1910, Das Tier-  
reich, XXIV, pp. 566, 802, 838.

**FEMALE.**—Shows the following characters in addition to those common to all species of the genus: Color largely light brownish rufous, without any black; antennæ with 15 segments; mesonotum entirely, rather closely, rather coarsely puncto-rugose; parapsidal grooves almost continuous, moderately broad and distinct at the scutellum, broader than in any other variety of the genus; median groove somewhat evident for a short distance; mesopleuræ almost wholly puncto-rugose, light brownish rufous; foveæ distinct, broadly separated, of moderate size, largely rugose at bottom, in small part almost smooth; abdomen light brownish rufous, darker posteriorly especially dorsally, smooth, naked except for a few hairs latero-basally, posterior segments finely, definitely reticulated, most faintly so posteriorly, longer than high, the second segment covering fully two-thirds the area; legs largely light brownish rufous, only slightly browner on the coxæ and the tibiæ; cubitus complete but very fine and faint at the basalis; areolet of moderate size or rather large, elongate on the cubitus; length averaging close to 3.0 mm.

**GALL.**—Quite similar to the galls of the other agamic forms of the genus; generally large, robust, up to 20. mm. in diameter and 28. mm. long; usually more irregular, composed of rather distinct, rounded parts, more or less fused; internally inclined to become partly hollow, the larval cells closely embedded, not very distinctly lined. On twigs of *Quercus virginiana*.

**RANGE.**—Florida, Georgia, and possibly elsewhere. The typical variety confined to an area including Jacksonville, Florida.

**TYPES.**—In the U.S. National Museum, The American Museum of Natural History, the Philadelphia Academy of Natural Sciences, the



Museum of Comparative Zoology, and the Beutenmuller collection (?). From the neighborhood of Jacksonville (?), Florida; Ashmead collector.

At this time I can add little to our knowledge of this species because I do not have insects enough to determine how many varieties it may have, and the range and hosts of each. The above descriptions, made from types, will separate this species from others of the genus, and give further details probably characteristic of only the typical variety. I have galls from a number of localities in Florida and Georgia, representing certainly more than one variety. Moreover some of the galls are from *Quercus virginiana*, some from *Q. laurifolia*, and some from *Q. stellata*. Probably each host has a distinct form for each faunal area. The *Q. stellata* galls from Georgia may represent a variety of *Plagiotrichus elongatus*, altho the galls are more like *batatoides* galls.

Dozier states that galls collected early in December gave adults late in January; Weld bred adults on April 12, 1914. All of my galls were collected early in November, and I failed to secure adults probably because the larvæ were still too young when the galls were dried. These galls are pecked into by birds and gnawed by mice, as Ashmead also recorded with the original description. Older galls persist on the trees until many of the live oaks are thickly covered with them. They are the favorite abode of ants which tunnel the soft tissue, further its early decomposition, and establish their colonies inside. Many of the old galls are almost hollow, covered by mostly complete bark, but internally a mass of thinly separated tunnels and decomposing chewings.

The insect shows very distinct relationships to the other white oak species of the genus, rather than to the black oak species, but in many respects it is the most unique of the white oak species. The discovery of other varieties may link it more directly with some other species. *Plagiotrichus elongatus rufopleuræ*, occurring in Texas on *Quercus breviloba*, is in some respects similar to *batatoides*, but more closely related to the other varieties of *elongatus*.

### ***Plagiotrichus chrysolepidicola* (Ashmead)**

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color largely rufous, sometimes in part shaded to black; apical half of antenna darker than basal half; mesonotum closely, finely puncto-rugose, sometimes in part puncto-

shagreened, entirely and rather closely hairy; foveæ distinct, usually well separated; abdomen smooth, not at all reticulated, finely punctate only on the edge of the last segment, moderately hairy, longer than high in some varieties, not as long as high in others, the second segment not covering more than half the area; cubitus more or less complete, faint or practically lacking at the basalis in some varieties; length 1.5-3.5 mm.

GALL.—Similar to those of most species of the genus. Swelling up to 20. mm. in diameter by 70. mm. long, usually much smaller; the larval cells distinct, more or less imbedded in the wood, usually not completely surrounded by wood, never separable. On white oaks.

RANGE.—California and Oregon. Apparently confined to the Pacific Coast states.

I have grouped the following varieties into one species because they are all so closely related that further subdivision is not logical (as discussed under *diminuens*); because they all occur on white oaks in the Pacific Coast region, and are abundantly different from the black oak varieties of the same region. The most closely related varieties I have yet seen are the white oak varieties from the Rocky Mountain region, here treated as species *frequens*. In no case are these varieties as generally dark in color, or the abdomen as naked as in *frequens*. But inasmuch as in most other respects varieties of both groups are so similar, it must be borne in mind that *frequens* and *chrysolepidicola* are closely related, if they should not be considered one species.

The insects emerge very early in the spring, from February 7 in southern California to April 7 in Oregon. New galls were found in some instances at about the same dates, too soon to have been produced by the insects then emerging, suggesting the possibility of the species having an alternate generation which takes a full year for its growth. The galls are abundant wherever white oaks occur, each variety being confined as far as known to a single species of oak, and where that oak ranges over more than one faunal area there will be as many varieties of the insect.

It is unfortunate that the first variety described was named *chrysolepidicola*, which wrongly defines the habits of most of the varieties. If *P. congregatus* (Ashmead) should prove to be the bisexual generation of any of these varieties, that name will take precedence for this species.

**Plagiotrichus chrysolepidicola** variety **chrysolepidicola**  
(Ashmead)

*Cynips chrysolepidicola* Ashmead, 1896, Proc. U.S. Nat. Mus., XIX, p. 124. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 59; 1910, Das Tierreich, XXIV, pp. 439, 802, 829. Thompson, 1915, Amer. Ins. Galls, pp. 7, 26.

*Callirhytis chrysolepidicola* Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 354. Felt, 1918, N.Y. Mus. Bull., 200, p. 59.

**FEMALE.**—Shows the following characters in addition to those common to all varieties of the species: Color generally a rather light rufous brown; antennæ bright rufous, the apical half brown; parapsidal grooves indistinct but traceable for the mesonotal length, broader posteriorly than in *kelloggi*; median groove distinct for the mesonotal length; anterior parallel lines evident, continuous, smooth; mesopleuræ in large part punctate and hairy, only in smaller part smooth; abdomen about as long as high; legs with the coxæ light rufous brown, the tibiæ, especially the hind tibiæ, dark brown; areolet of moderate size; cubitus about continuous; length 2.-3. mm.

**GALL.**—Quite similar to the galls of other varieties of this species; rather small, elongate-ovate, up to 40. mm. in length by about 15. mm. in diameter. On *Quercus chrysolepis*?

**RANGE.**—California: "Pine Canyon", Martinez (Ashmead).

**TYPES.**—Adults and galls at the U.S. National Museum. Labelled January 8, 1883, and February 9, 1884; Martinez (and elsewhere?), California; Koebele collector.

I have seen only type material of this variety. The insect is remarkably like that of variety *alutaceus*, differing mainly in having the parapsidal grooves less convergent at the scutellum and the median groove distinctly continuous; the gall is not inflated and partly hollow as in *alutaceus*, but is solid as in most of the varieties of this species. We must see material of other collections before we can be certain what this name represents. *Quercus chrysolepis* bears similar galls of some other species, *P. asymmetricus* and *Andricus spectabilis*, and possibly I have overlooked *chrysolepidicola* galls for this reason. The hosts of the type galls are not certain, however; the pin label records a live oak as host, and it is not impossible that Ashmead merely surmised *chrysolepis* as the host. The bark of the type galls is certainly not very typical of *chrysolepis*. Finally, the inclusion of at least two distinct collections of galls in the types makes the question of host more uncertain.

**Plagiotrichus chrysolepidicola** variety **kelloggi** (Fullaway)

*Cynips kelloggi* Fullaway, 1911, Ann. Ent. Soc. Amer., IV, pp. 345, 370.  
\* Felt, 1918, N.Y. Mus. Bull., 200, p. 56.

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally a rather light rufous brown; antennæ bright rufous, the apical half brown; parapsidal grooves entirely indistinct but traceable for most of the mesonotal length; median groove traceable for most of the mesonotal length; anterior parallel lines rather evident, continuous, smooth; mesopleuræ in large part, almost, but not entirely, smooth, shining, more or less naked, a distinctly rugose area medianly, bright rufous brown; foveæ not large, more or less smooth at bottom; abdomen darker only postero-dorsally and less so ventrally, longer than high; legs including the coxæ bright rufous brown, hardly darker on the hind tibæ; areolet very small; cubitus faint at the basalis; length 2.0-3.0 mm., averaging smaller.

GALL.—Quite similar to the galls of most of the varieties. More or less rounded, up to 25. mm. in diameter and 40. mm. long, averaging nearer 10. mm. in diameter by 20. mm. long. Internally quite solid, the larval cells more or less closely embedded. On *Quercus Douglasii*.

RANGE.—California: Cupertino, Stanford University, Frohm, Paso Robles, San Jose (Fullaway); Palo Alto, Byron, Oakdale, Three Rivers, El Portal. Probably from Palo Alto and El Portal south wherever *Q. Douglasii* occurs.

TYPES.—Females and gall at Stanford University; females at the U.S. National Museum and in my collection.

The above redescriptions are based on paratype females from Paso Robles, and on galls from the several localities in which I collected this species. I have critically examined insects only from Paso Robles, and all of the other locality records, based on galls only, are therefore open to question.

Galls collected in March and April were empty; young galls (not certainly of this variety) were just beginning growth at El Portal on March 26, 1920. If the insects overwinter in the galls they emerge early in the spring. The variety is probably confined to *Quercus Douglasii*, over the southern part of its range, for in the more northern Sierras, and north of San Francisco, this same oak bears different varieties, *compositus* and *atricinctus*, respectively. Galls were collected which had been broken into by mice or other small mammals in search of the insects as food.

The insect, in its color, size, smoother mesopleuræ, elongate abdomen, and more or less discontinuous cubitus, shows closest relationships to variety *diminuens*. It differs from *diminuens* mainly in having complete parapsidal grooves,



a complete median groove, and a smaller areolet. The larger, more robust gall, of greater diameter, is quite unlike that of *diminuens*. This latter variety, moreover, is confined to *Quercus dumosa*.

The Stanford laboratory records state that the single specimen from Cupertino was collected on *Q. dumosa*, and this specimen is labelled as holotype of *kelloggi*. If *dumosa* is the correct host of this specimen it is unlikely that it agrees with the paratypes which came from *Douglasii* at Paso Robles. The original description, however, agrees with the Paso Robles paratypes, and if it develops that the Cupertino material does not agree with the description it cannot remain as the holotype.

**Plagiotrichus chrysolepidicola variety *diminuens*, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally rather dark rufous brown, in part blackish; antennæ almost entirely brown, the apical half much darker, the first two segments golden rufous; parapsidal grooves distinct for only half or two-thirds of the mesonotal length, moderately convergent posteriorly; median groove practically absent; anterior parallel lines rather distinct; mesopleuræ very largely smooth, shining, naked, only centrally punctate, hairy, and limitedly and finely rugose; foveæ not large, rather smooth, wholly but not closely rugose at bottom; abdomen bright rufous laterally, distinctly dark rufo-piceous postero-dorsally and postero-ventrally, not very hairy laterally, longer than high; legs including the coxæ yellowish rufous, the tibiæ distinctly brown; areolet rather small; cubitus very faint at the basalis or actually discontinuous; length 1.5-2.5 mm., averaging about 2.0 mm., distinctly smaller than in any other variety.

GALL.—Differs from the galls of most of the other varieties in being much more slender and elongate, up to 9. mm. in diameter and 70. mm. long, often less in diameter; with the larval cells clustered in a more or less continuous cavity, the cell walls distinct from but attached to the wood. On *Quercus dumosa*.

RANGE.—California: Palo Alto, Paso Robles, Pasadena, Santa Catalina Island, Fallbrook, Sorrento, Alpine, Descanso.

TYPES.—42 females, 38 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Palo Alto, California; March 13, 1920; *Q. dumosa*; Kinsey collector.

Insects were emerging at Pasadena on February 7, 1920; some emerged after February 23 at Descanso, after February 26 at Fallbrook, and after March 7 at Paso Robles. In the

later collections the galls showed some of the adults to have emerged earlier. The Alpine, Sorrento, and Santa Catalina records are based on galls alone; from all the other localities I have the insects. Galls of this variety were in several instances confused in collecting with galls of variety *alutaceus*, the two growing together on the very same trees and twigs. But a fine series of *diminuens* insects was bred from a pure collection of slender galls from Descanso, and large series of *alutaceus* were bred from pure collections of inflated galls from Upland, San Jacinto, and the Santa Catalina Island; so I do not believe I have connected the insects of these two varieties with the wrong galls.

In its color, size, smoother mesopleuræ, elongate abdomen, and more or less discontinuous cubitus, the insect shows closest relationships to *kelloggi*. It differs from *kelloggi* in having incomplete parapsidal grooves, no median groove, and a somewhat larger areolet. The smaller, more slender gall, regularly of smaller diameter, is quite unlike the gall of any other Pacific Coast variety in the genus, altho individual galls of other varieties will occasionally resemble this gall. As far as known the insect inhabits only *Quercus dumosa*, occurring over a remarkably wide range, at least from Palo Alto to Descanso, a distance of about five hundred miles without apparent variation. I am not at all certain that all of this area should be considered one faunal zone. It may be that only the *Q. dumosa* fauna remains southern as far north. At any rate I do not find variations in material of this variety from this wide range. *Alutaceus*, another variety of this same species, also occurs on the same oak over the same range. In all of my abundant material I do not find gradations between the two. It will be questioned whether these two varieties, not separated by host or geographic isolation, should not be considered distinct species. It is true that the galls are very distinct, *alutaceus* galls being very similar to those of practically all of the other varieties I have included in this species. *Diminuens* galls suggest those of some of the varieties of *Plagiotrichus elongatus* Kinsey, of Texas; but the adult is related to the other California insects rather than to the Texas insects. Altho *alutaceus* is close to *diminuens* in some characters, it nevertheless differs in other important regards, as listed under *alutaceus*, closely resembling the *pugnus-atricinctus* group of varieties. One cannot properly

make an independent group of *kelloggi* and *diminuens* without including *alutaceus*, which in turn would require the inclusion of all of the varieties as I have treated them. Any arbitrary line drawn for species would be so contrary to facts as to mitigate what convenience might be gained. Up to date I know of few other instances of two related forms occurring in the same faunal area on the same host except where the forms can be considered as belonging to distinct species. But nature does not order things to fit man's taxonomic invention. Here she is evolving two distinct forms which will some day become our "species", just how we cannot understand since there are no isolation factors present; and how to adequately express the situation is beyond a convenient taxonomic scheme.

**Plagiotrichus chrysolepidicola variety alutaceus, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally a rather light rufous brown; antennæ bright rufous brown, the first two segments golden rufous, the apical segments brown; parapsidal grooves entirely indistinct but traceable for most of the mesonotal length, more closely converging posteriorly than in *kelloggi*; median groove hardly discernible except posteriorly; anterior parallel lines rather evident, continuous, smooth; mesopleuræ entirely but rather finely punctate, hairy, and rugose, most rugose medianly, in no place as smooth as in *kelloggi*, rufous brown; foveæ large, rather finely separated, entirely, 'sparingly, but rather deeply rugose at bottom; abdomen darker only postero-dorsally and less so ventrally, longer than high; legs including the coxæ bright rufous brown, the tibiæ and tarsi, especially of the hind legs, dark brown; areolet of moderate size or moderately large; cubitus distinct to the basalis; length 2.0-2.7 mm., averaging smaller.

GALL.—Similar to the galls of most other varieties of the species; generally robust, up to 20. mm. in diameter by 40. mm. long, somewhat irregular, smoothly gnarled; internally with a considerable cavity (in the mature gall only) broken by irregular crossed bands of hard wood, and more or less completely filled by clustered, somewhat fused larval cells. On twigs of *Quercus dumosa*.

RANGE.—California: Alpine, Sorrento, Fallbrook, El Toro, San Jacinto Mountains, San Bernardino (?), Upland, Pasadena, Santa Catalina Island, Paso Robles, Gilroy (Redwood School), Palo Alto. Probably from El Portal and Palo Alto south, wherever *Q. dumosa* occurs.

TYPES.—16 females, 37 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at the U.S. National Museum, Stanford University, and with the author; paratype galls at the Museum of Comparative Zoology and the Philadelphia Academy. Labelled Pasadena, California; February 7, 1920; *Q. dumosa*; Kinsey collector.

Insects were emerging from Pasadena galls on February 7, 1920; they emerged sometime after collecting at Upland on February 3, on the Santa Catalina Island on February 11, at Alpine on February 24, at San Jacinto Mountain on February 28, and at Palo Alto on March 13. Several collections made early in March failed to give any adults at all. Apparently most of the insects emerge in February. Galls gathered even a short time before they were quite mature retained many dead adults later, prevented from emerging by the too early drying of even such a woody gall. Repeatedly galls were found which had been broken into and considerably gnawed by mice or other small mammals in search of the larvæ or pupæ as food.

This insect is distinct from all other varieties of the species in having more closely convergent parapsidal grooves; the more punctate and hairy mesopleuræ, the larger areolet, and the distinctly larger size separate the insect from *kelloggi* or *diminuens*. The robust gall is very different from the slender gall of *diminuens*. In general color and elongate abdomen the insect shows relations to *kelloggi* and *diminuens*, but in its size, more hairy abdomen, and continuous cubitus it is related to the *pugnus-atricinctus* group of varieties. The variety occurs on *Quercus dumosa*, on the very same trees in all the wide range from which I collected *diminuens*. Under *diminuens* I have discussed the possibility of considering these two distinct species.

### **Plagiotrichus chrysolepidicola** variety **atricinctus**, new variety

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally rufous brown, with a distinct darker to black shading; antennæ brown, only the first two segments golden rufous, darker brown terminally; parapsidal grooves rather distinct to the pronotum; median groove more or less traceable to the pronotum; anterior parallel lines and lateral lines more distinct, broader, more smooth than in other varieties; mesopleuræ rufous, largely but sparsely punctate and hairy, with small, smoother, naked areas beneath the tegulæ and on the ventral margin; foveæ shining, but sparingly rugose at bottom; abdomen darker, especially postero-dorsally, sometimes in part approaching black, not as long as high; legs including the coxæ bright rufous brown, brown on the tibiæ and tarsi, distinctly dark brown on the hind tibiæ; areolet of moderate size or only moderately small; cubitus distinctly complete; length 2.0-3.0 mm., averaging larger.

GALL.—Similar to the galls of most other varieties; robust, up to 15. mm. wide by 30. mm. long, usually smaller; internally quite dense,



solid, the larval cells rather completely surrounded by wood. On *Quercus Douglasii*.

RANGE.—California: Napa, Auburn, Redding. Probably confined to the more northern range of *Q. Douglasii*.

TYPES.—28 females, 36 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, Stanford University, and with the author. Labelled Napa, California; March 18, 1920; *Q. Douglasii*; Kinsey collector.

The insects emerged after collecting at Napa on March 18, 1920; galls collected later further north, at Auburn, on March 31, and at Redding on April 2, showed all of the adults to have emerged previously.

The solid, woody gall is quite like those of the two other varieties on *Douglasii*, namely *kelloggi* further south and *compositus* along the Sierras north of the Merced River. It is similar to but definitely distinguished from the varieties on other oaks. The insect is best distinguished by the broad lateral lines; it is entirely different in color as well as in some other characters from *kelloggi* which occurs on the same oak. In color it resembles *compositus*, *pugnus*, and *pugnoides*, but is distinct from all of these in having a more or less completely traceable median groove; from *garryanæ*, which is of a similar color and possesses a very much fainter median groove, it is distinguished by the more definite median groove and parapsidal grooves anteriorly, the broader lateral lines, more largely smooth foveæ, and complete cubitus. Nevertheless *atricinctus* and *garryanæ* are largely similar, just as their adjacent ranges would lead one to expect. The galls of these two, however, are distinct, as are the hosts and ranges.

### **Plagiotrichus chrysolepidicola** variety **compositus**, new variety

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally dark rufous and brown to piceous black; first two segments of the antennæ yellow rufous; parapsidal grooves fine, narrow, continuous to the pronotum; median groove absent; anterior parallel lines not wholly smooth; mesopleuræ dark rufous brown, largely smooth, scatteringly punctate, most so medianly, sparsely hairy; foveæ rather small, wholly, not closely rugose; abdomen rufous to brown and piceous, mostly dark, not very hairy, not as long as high; areolet of moderate size; cubitus not continuous; length 2.0 mm.

GALL.—Similar to the galls of other varieties of the species; robust, up to 12. mm. in diameter by 28. mm. long; internally rather solid, the larval cells rather closely embedded. On *Quercus Douglasii*.

RANGE.—California: Merced Falls (Placerville?). Probably ranges from the Merced River northward, at least to the American River, wherever *Q. Douglasii* occurs.

TYPES.—1 female, 30 galls. Holotype female, paratype galls at The American Museum of Natural History; paratype galls at the U.S. National Museum, Stanford University, the Philadelphia Academy, the Museum of Comparative Zoology, and with the author. Labelled Merced Falls, California; March 28, 1920; *Q. Douglasii*; Kinsey collector.

Apparently only a single insect had not emerged at the time of collecting, March 28, at Merced Falls. Fresh galls, only presumably of this variety, were found at Placerville on March 30. Many of the galls had been eaten into, and in some cases so deeply that I am inclined to credit part of the work to birds rather than to mice; probably the galls are softer when still fresh, and more easily broken into.

The insect combines characters of *diminuens*, *pugnus*, and other varieties. It differs from *diminuens* in having complete parapsidal grooves, the abdomen not as long as high, and the general color darker; it differs from *pugnus* in having complete and finer parapsidal grooves, a less hairy abdomen, and a larger areolet. It is distinct from *kelloggi* in color, absence of median groove, and shape of abdomen; and from *atricinctus* in size, absence of median groove, color of mesopleuræ, and other minor details.

The type localities of the three varieties occurring on *Q. Douglasii* are rather widely separated. *Kelloggi*, from Cupertino and Palo Alto, may be confined to the more southern and western range of *Douglasii*; *atricinctus*, from Napa, may be the most northern of the varieties; *compositus*, from Merced Falls, may range from the Merced River northward at least to the American River. Unfortunately I do not have many insects of these three varieties, and the galls are all so similar that they are not sufficient for determining distributions. The ranges suggested are based on my experience with other Cynipidæ, but must be verified for these three varieties.

I do not want to make a practice of describing new Cynipidæ from single specimens, but in this instance the insect is distinct, and a study of series of the related varieties shows no variation toward this form; so I may be pardoned for this description. It should draw attention to the existence

of the variety, and invite further data from other workers the sooner.

**Plagiotrichus chrysolepidicola** variety **pugnus**, new variety

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally dark rufous or chestnut brown and black; antennæ almost entirely brown, the first two segments rufous, the terminal segments darker brown; parapsidal grooves distinct, narrow, but slightly broader and smoother at bottom than in other varieties, practically obsolete for the anterior half or third of the mesonotum; a short median groove just evident; anterior parallel lines not entirely smooth; mesopleuræ rufous, largely smooth and naked beneath the tegulæ, medianly finely rugoso-punctate and hairy; foveæ of moderate size, smooth and shining, very sparingly rugose at bottom; abdomen in part rufous, banded rufous brown about the edges of the second and third segments, and generally dorsally and ventrally, not as long as high; legs brownish rufous, the bases of the coxæ, the tibiæ, and tarsi brownish, the hind tibiæ dark brown; first abscissa of the radius rather broadly infuscated at the subcosta; areolet of moderate size or moderately small; cubitus about continuous; length 2.2-2.8 mm.

GALL.—Similar to the galls of other varieties of the species; more irregular in shape, knotted, sometimes rather fist-like, up to 25. mm. in diameter by 40. mm. long; internally solid, woody, the larval cells closely embedded; on *Quercus lobata*.

RANGE.—California: Three Rivers, Exeter. Probably confined to the more southern range of *Quercus lobata*.

TYPES.—7 females, 19 galls. Holotype female, paratype galls at The American Museum of Natural History; paratype females and galls at the U.S. National Museum, Stanford University, and with the author. Labelled Exeter, California; March 22, 1920; Kinsey collector.

Most of the insects had emerged before the date of collecting at Exeter on March 22, 1920.

This variety, in both insect and gall characters, much more closely resembles *pugnoides* than any other variety of the species. *Pugnus* is to be distinguished by the rufous mesopleuræ, the smaller areolet, and generally smaller size. Both insects occur on the same oak, *lobata*, but as far as collected *pugnus* appears to be more southern than *pugnoides*. The variety next most closely related to these two is *garryanæ*, occurring still further north on *Quercus garryana*.

**Plagiotrichus chrysolepidicola** variety **pugnoides**, new variety

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally dark rufous or chestnut brown and black; antennæ almost entirely brown, the first two segments rufous, the terminal segments darker brown; parapsidal

grooves distinct, smooth at bottom, not quite as wide as in *pugnus*, practically obsolete for the anterior half of the mesonotum; a short median groove just evident; anterior parallel lines not entirely smooth; mesopleuræ piceous black, mostly smooth and naked beneath the tegulæ, medianly finely rugoso-punctate and hairy; foveæ rather larger, mostly smooth and shining but very sparingly rugose at bottom; abdomen in part rufous brown, banded rufo-piceous about the edges of the second and third segments, and generally dorsally and ventrally, not as long as high; legs dark rufous or chestnut, the coxæ basally, the tibiæ, and tarsi brown, the hind tibiæ almost black; first abscissa of the radius broadly infuscated at the subcosta; areolet of moderate size or larger, distinctly larger than in *pugnus*; cubitus about continuous; length 2.5-3.5 mm., averaging larger than in *pugnus*.

GALL.—Very similar to the gall of *pugnus*, irregular, knotted, up to 18. mm. in diameter and 60. mm. long; internally solid, woody, the larval cells closely embedded; on *Quercus lobata*.

RANGE.—California: Santa Rosa. Probably confined to a more northern part of the range of *Quercus lobata*.

TYPES.—10 females, 14 galls. Holotype female, paratype female, and galls at The American Museum of Natural History; paratype females and galls at the U.S. National Museum, Stanford University, and with the author. Labelled Santa Rosa, California; March 16, 1920; *Q. lobata*; Kinsey collector.

Many of the insects had emerged before collecting on March 16, 1920, at Santa Rosa.

This variety, in both insect and gall characters, much more closely resembles *pugnus* than any other variety of the species. *Pugnoides* is readily distinguished by the darker mesopleuræ, the larger areolet, and the distinctly larger size. The range of this variety appears to be intermediate between *pugnus* and *garryanæ*. *Garryanæ* shows somewhat close relationships to *pugnoides*.

### **Plagiotrichus chrysolepidicola** variety *garryanæ*, new variety

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally chestnut brown, with considerable black; antennæ brown, the first two segments brownish rufous, the last eight almost black; parapsidal grooves distinct for half the mesonotal length, barely evident anteriorly; median groove barely indicated for the mesonotal length, but not at all definite; anterior parallel lines distinct; mesopleuræ largely smooth and naked, medianly rugoso-punctate and hairy; foveæ rather small, wholly rugose; abdomen for the most part dark rufous brown to black, lighter rufous only latero-basally, not very hairy laterally, not as long as high; legs including the coxæ bright rufous, the tibiæ and tarsi brown, the hind tibiæ very dark; areolet rather small or distinctly small; cubitus not quite continuous; length 2.2-2.7 mm.



GALL.—Rather similar to galls of the other varieties; elongate, slender, regular, up to 14. mm. in diameter and 40. mm. long, usually more slender; internally woody, with somewhat of a cavity, the larval cells densely clustered and packed so closely sometimes (in one specimen especially) as to exclude wood in much of the gall. On *Quercus garryana*.

RANGE.—Oregon: Ashland, Grants Pass, Junction City. Probably California to British Columbia, wherever *Q. garryana* occurs.

TYPES.—4 females, 4 galls. Holotype female, paratype gall at The American Museum of Natural History; paratype females and galls with the author. Labelled Ashland, Oregon; April 6, 1920; *Q. garryana*; Kinsey collector.

Most of the insects had emerged before collection at Ashland on April 6; all of them had emerged before April 7 at Grants Pass.

This insect is to be distinguished by the darker color, the more or less complete median groove, and small areolet. In its general color and the shape of the abdomen, it resembles *pugnus*, but in the smoother mesopleuræ, less hairy abdomen, and somewhat discontinuous cubitus it tends toward *kelloggi* and *diminuens*. One cannot believe that it is necessarily originated from either group rather than from a more remote, common ancestor. Host isolation in this case is accompanied by geographic isolation, the combined forces offering splendid opportunity for the development of a distinct form.

### **Plagiotrichus coxii (Bassett)**

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color rufous, in large part shaded to black, usually solid black on the abdomen; antenna with 14 segments, with the apical half brown, the basal half brownish rufous; mesonotum relatively smooth, mostly finely reticulated or shagreened, entirely smooth between the anterior parallel lines, very sparsely hairy, most hairy on the scutellum and antero-laterally; parapsidal grooves continuous, narrow; median groove short or lacking; foveæ rather large, distinct, but separated by only a fine ridge; mesopleuræ smooth, shining, naked, a transverse, medial band finely shagreened; abdomen black, smooth, not reticulated, but the posterior segments finely punctate, mostly naked except for a few hairs latero-basally; as long as high, the second segment covering slightly more than half the area; legs rich rufous and brown, the coxæ dark; cubitus complete or just short of being complete; length 2.2-3.0 mm.

GALL.—A globose to elongate, solid twig gall. Polythalamous, averaging twenty or more cells to a gall. Smooth, covered with nearly normal bark, somewhat reddened; up to 20. mm. in diameter and 65. mm. in length. Internally rather solid but not entirely so, the larval cells

with a distinct lining, closely embedded in the less solid part of the tissue. On black oaks.

RANGE.—Arizona. Possibly also in New Mexico, western Texas, and Mexico, wherever *Q. Emoryi*, *Q. hypoleuca*, and related oaks occur.

The insect of this species is in several respects, particularly the almost naked mesonotum and the 14-segmented, short antennæ, extreme for this genus. But species like *P. suttonii* and *P. perdens* of California are intermediate between *coxii* and the white oak species of the genus. This emphasizes the artificial nature of our sharp generic lines. I doubt whether I should consider the species in this genus except for the additional evidence furnished by the gall. It is typically a *Plagiotrichus* gall, related more closely to the other black oak species, as is the insect also, than to any other white oak species.

The insects emerge in midwinter, December and January. The young galls appear immediately, which suggests that they arise from an alternate generation, the whole life cycle taking more than one year.

I have galls from New Mexico which may belong to this species, but rather extensive collecting in both western Texas and New Mexico failed to give me other galls of this species. If the species occurs in those states, it certainly does not there reach the abundance with which it infests the black oaks of southern Arizona.

### *Plagiotrichus coxii* variety *coxii* (Bassett)

*Cynips Coxii* Bassett, 1881, Can. Ent., XIII, p. 112.

*Cynips coxii* Packard, 1881, U.S. Ent. Comm. Bull., VII, p. 57.

*Andricus Coxii* Ashmead, 1885, Trans. Amer. Ent. Soc., XII, pp. 295, 304; 1887, Trans. Amer. Ent. Soc., XIV, p. 132. Ashmead (in Packard), 1890, 5th Rpt. U.S. Ent. Comm., pp. 106, 110.

*Andricus coxii* Dalla Torre, 1893, Cat. Hymen., Cynip., II, p. 84. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 62; 1910, Das Tierreich, XXIV, pp. 530, 801, 825. Beutenmüller, 1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 465. Thompson, 1915, Amer. Ins. Galls, pp. 6, 31. Felt, 1918, N.Y. Mus. Bull., 200, p. 58.

*Andricus Coxii* Bassett, 1900, Trans. Amer. Ent. Soc., XXVI, p. 320.

*Andricus Bassettianus* Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 61.

*Andricus bassettianus* Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 532, 802, 838.

FEMALE.—Differs from the female of variety *translatus* as follows: Two basal segments of the antennæ rather dark brownish rufous.

of the same color as the third and fourth segments; parapsidal grooves converging more closely; areolet averaging moderately small.

GALL.—Very similar to the gall of *translatus*, differing in being more globoid, irregular, up to 20. mm. in diameter and 50. mm. in length, usually smaller. On *Quercus Emoryi*.

RANGE.—Arizona: Santa Catalina Mountains (Sabino Trail, 3000-4000 ft.), Oracle, Santa Rita Mountains, Fort Huachuca, Globe.

TYPES.—At the Philadelphia Academy of Natural Sciences. From near Tuscon, Arizona; on a live oak; E. T. Cox collector.

Galls which I collected in the Santa Catalina Mountains on January 1, 1920, contained mature larvæ; the adults emerged in abundance at some later date. Further south, in the Santa Rita Mountains, on January 6, and at Fort Huachuca on January 14, most of the adults had emerged from the galls, only a few emerging later, and at the same time young galls were to be found. Apparently emergence occurs as early as December. Further north, at Globe, on January 20, all of the adults but one had previously emerged from the galls I collected.

I have not been able to examine the Bassett types; my re-descriptions are made from galls and insects I collected in the Santa Catalina Mountains. This is a very characteristic species in the region, and altho the galls are of somewhat the same plan as those of *Andricus rugulosus* the insects are very distinct. There can be no question that my Santa Catalina material, from *Q. Emoryi*, represents the species and variety Bassett "received from Prof. E. T. Cox, who collected them near Tuscon, Arizona, probably from one of the dwarf live oaks of that region." Inasmuch as oaks do not grow nearer to Tuscon than in the Santa Catalina Mountains, and *Q. Emoryi* is the first oak met with along the trail, and the only black oak up to about a five thousand foot elevation, it is probable that Professor Cox's material came from this oak in these mountains. The only other variety I have found occurs at a higher elevation, on *Quercus hypoleuca*, and its large areolet does not fit Bassett's description of *coxii*. The galls I collected at Globe are labelled *Q. arizonica*, but I think I may have made some mistake in the record.

In 1900 Bassett redescribed *coxii* as a new species, using the same name, giving a nearly exact redescription, based on the same material as that used for the first account. Dalla Torre and Kieffer, 1902 and again in 1910, ignoring the obvious, considered the redescription a new species, took *coxii*

to be preoccupied, and substituted *bassetianus*, as Beutenmuller pointed out in 1907. Unfortunately this is not the only instance of the catalog method which has muddled cynipid taxonomy. *Coxii*, for instance, has been mentioned in the literature at least fourteen times. In not a single instance have any data been given beyond that of the original description. Ashmead's guess (1887), copied by Dalla Torre and Kieffer (1910), that the species occurs on the Californian oak, *Quercus agrifolia*, is of course wrong. Some museum material from California is labelled *coxii*; it is *suttonii* instead.

***Plagiotrichus coxii* variety *translatus*, new variety**

FEMALE.—Differs from the female of variety *coxii* as follows: Two basal segments of the antennæ bright rufous, brighter than the third and fourth segments; parapsidal grooves not as closely convergent, sometimes considerably further apart at the scutellum; areolet averaging rather large, sometimes considerably larger.

GALL.—Very similar to the gall of *coxii*, differing in being more regularly cylindrical, elongate, up to 15. mm. in diameter and 65. mm. long. On *Quercus hypoleuca*.

RANGE.—Santa Catalina Mountains (Sabino Trail, 5000-8000 ft.). Probably also occurs on *Q. hypoleuca* in the neighboring mountain ranges.

TYPES.—18 females, 14 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at the U.S. National Museum, Stanford University, and with the author. Labelled Santa Catalina Mountains, Arizona; January 1, 1920; *Q. hypoleuca*; Kinsey collector.

The majority but not all of the adults had emerged from the type galls before January 1, 1920; young galls were developing at the same time.

This variety is very closely related to *coxii*, but averages distinct as described; even tho individuals of one variety may vary in regard to a single character toward individuals of the other variety, other characters will be distinct. The host, *hypoleuca*, occurs in a distinct zone above the altitudes occupied by *Emoryi*.

***Plagiotrichus elongatus*, new species**

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color largely rich rufous and black, in large part dark rufous; apical half of antenna darker or not; mesonotum closely, finely puncto-rugose, entirely and rather closely hairy; parapsidal grooves not continuous to the pronotum; median groove very short or wanting; mesopleuræ in part or largely puncto-rugose and



hairy; foveæ distinct or indistinct, smooth or rugose at bottom; abdomen smooth, more or less finely punctate and even indefinitely reticulated, largely naked, very sparsely, rather finely hairy, the second segment covering a full half of the area; cubitus distinctly continuous; length 2.2-3.0 mm.

GALL.—Slight twig swelling, elongate in two varieties, globoid in one. Monothalamous or polythalamous, one to fifty or more cells in a cluster. The swelling slight, two or three times the normal stem diameter, up to 8. mm. in diameter, averaging 60. mm. long in two varieties, 8. mm. long in one; covered with normal bark. Internally solid except for an irregular, more or less continuous cavity completely filled by crowded, distorted, larval cells, each cell separate, with a distinct lining, but not separable. Near the tips of twigs of *Quercus stellata* and *Q. breviloba*.

RANGE.—Texas: Austin. Probably thruout a part of Texas and Louisiana.

Dr. Patterson discovered and bred the insects of all the following varieties.

The insect of variety *elongatus* is very closely related to the varieties of *Plagiotrichus frequens*, differing only in being less black and in having the thorax more hairy. The insect of variety *rufopleuræ* shows some relation to *Plagiotrichus batatoides*, having the antennæ of uniform color and the abdomen very faintly reticulated; but it differs decidedly in many other respects. On a whole, tho, these three Texas insects are more closely related to each other than to the insects of the other species; so it is worth treating them as a distinct species. Beyond exhibiting the same generic characters, the galls are not similar to those of either *frequens* or *batatoides*.

The three insects differ in regard to a few characters only, but these are so differently combined as to make three remarkably distinct varieties. Any one of them might be considered intermediate between the other two. This may be more evident if one thinks of three varieties having nine points in respect to which they vary. Each of these varieties may have three characters which are unique to it, three which are shared with one of the other varieties, three which are shared with the third variety. This may be represented as follows:

Variable characters	1	2	3	4	5	6	7	8	9
Not unique to variety A	1	2	3	4	5	6			
Not unique to variety B					4	5	6	7	8
Not unique to variety C	1	2	3					7	8

In such a case any one of the varieties is midway between the other two. Practically this ideal arrangement often exists in nature, as may be discovered by comparing, word for word, my descriptions of the varieties of many species of Cynipidæ. Unfortunately it is too often the practice to choose one of such a set as the victim and call it a "hybrid", neglecting to see that any one stands in a similar relation to the others! Even when the proportion is not so equal we are not warranted in believing any one the product of the other two, for we really know little about the occurrence or nature of hybrids, and particularly little concerning their occurrence in the field; most of our field hybrids are pure assumptions, recognized by preconceived notions as to how a hybrid should look. I am not inclined to account any of these varieties of *elongatus* hybrids. Large series of each variety are remarkably uniform, even tho all three forms come from one locality, and altho I know little about it I should expect to find hybrids showing several degrees of intermediates, with individuals of one variety varying toward those of another.

The galls of two of these insects are very similar, the gall of the third is very distinct, altho still showing the specific relations.

The most interesting question raised by the species is that of the relation of the varieties to their hosts. Up to date each variety has been taken from only a single species of oak, but *elongatus* and *rufopleuræ* both occur on *Quercus breviloba*. I rather expect to find each variety restricted to a single faunal area, all three areas meeting at Austin, but not until we have further collecting can this be determined finally.

### **Plagiotrichus elongatus** variety **elongatus**, new variety

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Antennæ brown apically; parapsidal grooves distinct for three quarters or more of the length of the mesonotum; median groove wanting; mesopleuræ puncto-aciculate, in part entirely smooth, less hairy than in the other varieties, usually bright rufous; foveæ small, very narrow, smooth at bottom; abdomen averaging lighter than in *stellatæ*, especially posteriorly; legs brownish rufous, coxæ wholly rufous, the tibiæ and the hind legs in general tending toward a dark brown; wing veins averaging slightly finer than in *stellatæ*, especially the first abscissa of the radius; areolet of moderate size or larger; slightly smaller in build than in *stellatæ*, particularly in the width of the thorax and the size of the abdomen.

GALL.—An elongate, slight swelling; polythalamous, with fifty or more larval cells; differing from the galls of variety *stellatæ* in being more regular, of more uniform diameter up to 6. mm. On twigs of *Quercus breviloba*.

RANGE.—Texas: Austin.

TYPES.—200 females, 3 galls. Holotype female, paratype females, and gall at The American Museum of Natural History; paratype females and galls with the author; paratype females at the U. S. National Museum, Stanford University, and the Museum of Comparative Zoology. Labelled Austin, Texas; March 20, 1922; *Q. breviloba*; Patterson collection number 24.

Patterson states that these galls were first noticed in December, altho they doubtless had formed much earlier. Pupæ were in the galls about the first of January, and adults emerged during the first two weeks of March.

### **Plagiotrichus elongatus variety stellatæ, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Antennæ brown apically; parapsidal grooves not evident for more than half the length of the mesonotum; median groove wanting; mesopleuræ almost wholly puncto-rugose, more hairy than in *elongatus*, in part or wholly dark to black; foveæ not distinct, wholly rugose at bottom; abdomen averaging darker especially posteriorly; legs rufous brown, coxæ darker basally, the hind coxæ almost black, the tibiæ and the hind legs in general tending toward a black; wing veins averaging moderately heavy, especially the first abscissa of the radius, areolet of moderate size only; averaging slightly larger in build than in *elongatus*, particularly in the width of the thorax and the size of the abdomen.

GALL.—An elongate, slight swelling; polythalamous, with a score of larval cells. Differing from the gall of variety *elongatus* in being more irregular, of varying diameter up to 8. mm. On twigs of *Quercus stellata*.

RANGE.—Texas: Austin. Probably thruout a part of Texas and Louisiana.

TYPES.—93 females, 3 galls. Holotype female, paratype females, and gall at The American Museum of Natural History; paratype females and galls with the author; paratype females at the U.S. National Museum, Stanford University, the Philadelphia Academy, and the Museum of Comparative Zoology. Labelled Austin, Texas; March 23, 1922; *Q. stellata*; Patterson collection number 168.

Patterson bred the first adults from March 14 to April 3, 1922; he found insects still emerging on April 2.

### **Plagiotrichus elongatus variety rufopleuræ, new variety**

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally rich rufous and

black; antennæ almost wholly bright yellow rufous; parapsidal grooves distinct for only a little more than half the length of the mesonotum, longer than in *stellata*, shorter than in *elongatus*; a short median groove often apparent; mesopleuræ wholly puncto-rugose, more hairy than in *elongatus*, wholly brownish rufous; foveæ large, broad, largely smooth at bottom; abdomen averaging darker than in *elongatus*, especially posteriorly, the second segment covering a full half of the area; legs brownish rufous, coxæ wholly rufous, the tibiæ and the hind legs in general tending toward a dark brown; wing veins averaging slightly heavier especially the first abscissa of the radius; areolet of moderate size only; averaging larger in build than either other variety, particularly in the width of the thorax and the size of the abdomen.

GALL.—Short, globoid stem swelling, diameter up to 8. mm., length not over 12. mm.; rather distinct from galls of the other two varieties, monothalamous or polythalamous, with only four cells at the most. On *Quercus breviloba*.

RANGE.—Texas: Austin.

TYPES.—18 females, 7 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at the U.S. National Museum, and with the author. Labeled Austin, Texas; March 30, 1920; *Q. breviloba*; Patterson collection number 167.

Patterson bred insects on March 30, 1920.

The gall of this variety is very distinct from those of the other two varieties, especially in its much reduced number of larval cells. These cells, however, are quite like those of the other galls of the species.

### **Plagiotrichus frequens (Gillette)**

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color largely dark rufous and black, in large part black; antennæ with 14 segments, apical half of antenna darker; mesonotum closely, finely puncto-rugose, entirely but quite sparsely hairy; parapsidal grooves distinct to the pronotum; median groove absent; mesopleuræ largely smooth and naked, irregularly, scatteringly, finely rugoso-aciculate; foveæ distinct; abdomen smooth, not at all reticulated, finely punctate only on the edge of the last segment; almost naked of hairs except for a scatteringly few latero-basally; longer than high, the second segment not covering more than half the area; infuscation on the first abscissa of the radius limited but rather heavy; areolet of moderate size; length 1.7-3.0 mm.

GALL.—Similar to the galls of the other agamic forms of this genus. A stem swelling, up to 25. mm. in diameter and 110. mm. in length, usually smaller; internally rather woody, mostly solid, soft, spongy; the larval cells closely embedded, sometimes somewhat separable. On *Quercus Gambelii*, its varieties, or closely related oaks.



RANGE.—Colorado, Utah, Arizona, and probably New Mexico. Probably thruout the southern Rocky Mountains and adjacent regions wherever *Q. Gambelii* varieties occur.

The two known varieties occur in distinct faunal areas of the southern Rocky Mountains of Colorado. Inasmuch as that country involves so many other faunal areas, there are probably many other varieties of the species to be described. I have galls from *Q. Gambelii* varieties from several localities in Arizona and Utah that probably belong to this species. *A. rugulosus* Bassett and its varieties produce rather similar galls on evergreen white oaks of parts of the southwest, but those insects are generically distinct from *frequens*. As far as I know, *frequens* occurs only on the deciduous white oaks.

The species is most closely related to *P. chrysolepidicola* of the Pacific Coast, and it is not impossible that we shall consider these one species after other, intermediate varieties become known. *P. elongatus* of Texas is the next most closely related species, but *frequens* does not resemble *elongatus* nearly as closely as it does some of the varieties of *chrysolepidicola*.

Gillette described this species as from *Q. undulata*. I have seen it only from the white oak with large, long, deciduous leaves; this would appear to be *Q. Gambelii*, or one of its varieties or closely related species, according to the more recent treatments of these difficult oaks.

### **Plagiotrichus frequens variety frequens (Gillette)**

*Andricus frequens* Gillette, 1892, Ent. News, III, p. 247. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 63. Thompson, 1915, Amer. Ins. Galls, pp. 6, 32. Felt, 1918, N.Y. Mus. Bull., 200, p. 59.

*Callirhytis frequens* Mayr, 1902, Verh. Ges. Wien, LII, p. 289. Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 566, 806, 838.

FEMALE.—Differs from the other variety of the species as follows: Color mostly dark rufous to black on the head and thorax, varying to almost solid black; antennæ rufous basally, black terminally; foveæ rather small, distinctly smaller than in the other variety, black; abdomen wholly black; legs including the coxæ rufous, hind tibiæ dark to black; areolet of moderate size; length 1.7-2.5 mm.

GALL.—Quite identical with the gall of the other variety.

RANGE.—Colorado: Manitou. Probably confined to a limited region in Colorado east of the Continental Divide.

TYPES.—31 females, and galls. In the U.S. National Museum and in Gillette's collection. From Manitou, Colorado; May 8, 1892; C. P. Gillette collector.

The above redescription is based on a type female, and upon galls and poor adult material I collected at Manitou.

Gillette recorded the adult emerging on May 10, 1892. My galls were collected on April 24, 1920; they contained mature larvæ at the time, and these even pupated, but not a single adult matured to emerge. This was probably caused by the naturally corky nature of the galls, and their soaked condition after a season of much snow and rain, allowing too much shrivelling after collection. It is notable that the inquiline cynipids from these same galls did complete their metamorphosis. The galls are very abundant on the white oaks of the region. They are often partly destroyed by birds or mice.

This variety is closely related to *piceoderma*. It is different in having more black and in having distinctly smaller foveæ. As with other Cynipidæ, the varieties of Manitou and of Glenwood Springs are not the same.

#### **Plagiotrichus frequens variety piceoderma, new variety**

FEMALE.—Shows the following characters in addition to those common to the other variety of the species: Color mostly dark rufous on the head and mesonotum, the rest of the body mostly piceous black; antennæ rufous brown, brown terminally, bright rufous basally; mesopleuræ rufo-piceous to piceous or black, less often in small part bright rufous; foveæ rather large, distinct, black, somewhat smooth but more or less sculptured at bottom; abdomen dark rufo-piceous to piceous black, more rufous latero-basally; legs rather dark rufous, coxæ basally and tibiæ and tarsi darker, the middle and hind tibiæ dark brown; length 2.0-3.0 mm.

GALL.—Quite identical with the gall of the other variety.

RANGE.—Colorado: Glenwood Springs. Probably confined to a limited area in Colorado on the west of the Continental Divide.

TYPES.—166 females, 70 galls. Holotype female, paratype females, and galls at The American Museum of Natural History; paratype females and galls at the U.S. National Museum, Stanford University, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Glenwood Springs, Colorado; April 22, 1920; Kinsey collector.

On April 22, 1920, the galls at Glenwood Springs contained large larvæ; the adult insects emerged at some later date. The galls, as with galls of variety *frequens*, were quite soaked, soft, and rubbery, with the inside tissue stained brown

at the time of collecting, affected by the season of snow and rain. In spite of this a great number of insects matured in these galls. After a couple of years of drying the galls are still rather porous and more soft than are most galls of this genus.

This variety is very closely related to variety *frequens*, in both insect and gall characters. It differs rather distinctly from *frequens* in color and in having larger foveæ. In no case have I found the cynipid fauna of Glenwood Springs the same as that of Manitou on the east of the Divide, nor of Green River, Utah, on the west. The Glenwood Springs Cynipidæ are usually closely related to, distinctly intermediate with those from Manitou and Green River. I do not have material from any other locality of this fauna, and cannot guess at the extent of the area other than to believe it is limited.

### **Plagiotrichus perdens (Kinsey)**

FEMALE.—Shows the following characters in addition to those common to all species of the genus: Color largely dark rufous and black; antennæ black, only the two basal segments piceous black; mesonotum quite smooth and shining, finely reticulated, sparsely punctate and hairy, more densely punctate and hairy anteriorly; parapsidal grooves continuous to the pronotum, narrow, distinct; median groove just evident for the length of the mesonotum; anterior parallel lines hardly evident; foveæ broad, deep, shining, smooth; mesopleuræ rugoso-aciculate and hairy at top and bottom, a large, smooth, shining, and naked area centrally; abdomen smooth and shining, naked except for a few hairs latero-basally, posterior segments finely, scatteringly punctate; slightly longer than high, second segment occupying about half the area; legs rufous including the coxæ, most of the hind tarsi and tibiæ black; areolet moderately large; cubitus just continuous to the basalis but faint there; length 2.0-3.0 mm.

GALL.—Stem swelling, raggedly split open, containing flattened, seed-like cells. Polythalamous. Up to 13. mm. in diameter by 200. mm. long, averaging somewhat smaller. Within are large cavities, 4 or 5 arranged more or less radially about the axis of the stem, and a great many in series along the stem, each cavity sector shape, extending to the bark, 10. mm. or less in width at edge. Inserted on the wall of each cavity is a larval cell; each cell is monothalamous, flattened, a somewhat squared oval in outline, 4. mm. high by 3. mm. wide, broadest at the top; concave at the base with a projecting tongue by means of which it is inserted into the twig; cells smooth, shining, buff yellowish; finely streaked, more or less, with purplish brown. The cell walls are shell-like, moderately thick, entirely hollow within. At maturity the bark splits raggedly over each cavity, the larval cell drops to the ground, and the affected twigs die. On terminal twigs of *Quercus Kelloggii*.

RANGE.—California and Oregon. Probably wherever *Quercus Kelloggii* and *Q. Wislizenii* occur.

This species in several respects represents a considerable specialization for this genus. In no other species, as far as I know the genus, does the larval cell drop out of the gall before the insect emerges. The species is directly related to *Plagiotrichus suttonii*, which occurs on Pacific Coast black oaks; the galls of the two are distinct. These galls are very common on *Quercus Kelloggii* and *Q. Wislizenii*, but I am not certain that they occur on the other black oak of the Pacific Coast, *Q. agrifolia*. A couple of galls I collected at Descanso, California, on February 23, 1920, are recorded from *agrifolia*, but I cannot be positive of this determination, especially since the two oaks intergrade regularly in their southern range.

As I noted before, these galls kill the stems beyond the point of infestation, and thus kill the whole tree. Extensive stands of young black oaks are sometimes badly hurt.

I do not know when the insect matures; emergence occurs apparently after the larval cells drop to the ground. I found old galls, with no fresh galls evident, from January in southern California through April in Oregon.

### ***Plagiotrichus perdens* variety *perdens* (Kinsey)**

*Andricus perdens* Kinsey, 1922, Bull. Amer. Mus. Nat. Hist., XLVI, p. 286, pl. XXIV, figs. 5-7.

FEMALE.—Differs from the female of the other variety only in having the foveæ less wide, distinctly separate, and in averaging somewhat larger in size, up to 3.0 mm. in length.

GALL.—Differs from the gall of the other variety only in having the bark more roughened, the splitting more ragged. On *Quercus Kelloggii*.

RANGE.—California: Gilroy (Redwood School) (?), Placerville (?), Redding (?), Santa Rosa (?), Ukiah (?). Oregon: Ashland, Grants Pass, Roseburg.

TYPES.—2 females, 12 larval cells, and 26 infested twigs. Holotype female and paratype galls at The American Museum of Natural History; paratype female and galls with the author; paratype galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, and the Philadelphia Academy. Labelled Ashland, Oregon; April 6, 1920; *Q. Kelloggii*; Kinsey collector.

This variety is very similar to the variety on *Wislizenii*, as far as I can see differing only in the two characters described, slight differences in galls, and the different host. *Quercus*



*Kelloggii* ranges over more than one faunal area, so perhaps only the Oregon records apply to this variety. I have seen the insects only from Ashland, Oregon.

***Plagiotrichus perdens* variety *destructor*, new variety**

FEMALE.—Differs from the female of the other variety only in having the foveæ very much wider, continuous with a smooth area anteriorly, and in averaging somewhat smaller, up to 2.5 mm. in length.

GALL.—Differs from the gall of the other variety only in having the bark smooth, the splitting less ragged, less extensive. On *Quercus Wislizenii*.

RANGE.—California: San Bernardino (?), Three Rivers, Gilroy, (Redwood School), Oakdale, Boulder Creek, Mt. Tamalpais, Placerville, Ukiah. Very probably more than one variety is represented by these localities.

TYPES.—4 females, 40 galls. Holotype female, paratype galls at The American Museum of Natural History; paratype adults and galls with the author; paratype galls at the U.S. National Museum, Stanford University, and the Museum of Comparative Zoology. Labelled Boulder Creek, California; April 11, 1920; *Q. Wislizenii*; Kinsey collector.

At the time of publishing *perdens* it was noted that a "very similar if not specifically identical gall is found on *Quercus Wislizenii*". The insects from *Wislizenii* at Boulder Creek do not agree with the Ashland, Oregon insects from *Q. Kelloggii* in regard to the few characters described. Whether the differences are due to the different hosts, or to differences in distribution, or to both, I cannot say, for I have insects from only the two localities. Probably the varieties are restricted each to a single host, and each to a single faunal area, as is the case with the other California species of this genus.

***Plagiotrichus suttonii* (Bassett)**

FEMALE.—Shows the following characters in addition to those common to all agamic forms of the genus: Color generally bright rufous to brown and black; antennæ with 15 segments, brownish black, only the first two segments lighter; whole mesonotum relatively smooth, not closely punctured, very sparsely hairy; parapsidal grooves rather distinct for half the mesonotal length, hardly discernible anteriorly, not very convergent posteriorly; median groove entirely lacking; anterior parallel lines posteriorly rather broad and distinct; lateral lines in a very broad, smooth, naked area; mesopleuræ in part dorsally smooth and naked, elsewhere sparsely and finely puncto-rugose and at least in part hairy; scutellum quite rugose and hairy; foveæ rather large, broad, separated by only a fine ridge, largely smooth, sparsely rugose at the bottom; abdomen brilliant brownish rufous, solid black dorso-basally;

edges of third to last segments distinctly, closely punctate, the last segment reticulate; sparsely hairy latero-basally; the second segment covering slightly more than half of the area; abdomen about as long as high, or slightly longer or shorter; the tibiæ and tarsi darker, the hind tibiæ almost black; wing veins not heavy, the first abscissa of the radius hardly infuscated; areolet of moderate size to very large; cubitus not continuous, or very faint toward the basalis; length 2.5-4.0 mm., averaging large.

GALL.—Rather large, solid stem swelling. Polythalamous, with a great many cells. The swelling elongate or globose to massive, distinct but only moderately abrupt, solid, covered with normal bark, a somewhat distinct, smoother ring about the exit hole; internally very solid, entirely woody, the larval cell distinctly lined but closely embedded. On stems of all of the Pacific Coast black oaks.

RANGE.—California, Oregon. Probably also Washington and British Columbia, wherever black oaks occur.

The insects of this species emerge early in the spring, in February and March, earlier further south. The galls are hard and solid, and I have not found them eaten into by birds and mice as are the white oak species of *Plagiotrichus*.

The three varieties described here are confined to black oaks, each to a single species, all of the Pacific Coast black oaks being affected. Probably several varieties occur on each oak as it occurs in different faunal areas, but this has been proved only for the *agrifolia* varieties. This species is not so radically different from *Plagiotrichus chrysolepidicola*, but shows characters typical of the other black oak species of the genus. Its intermediate nature may be due to the close relations, probably dating from more remote geologic ages, of the black live oaks and the white live oaks of the Pacific Coast. I have included *coxii* and *asymmetricus* in this genus, even tho they are not closely related to some other species, mainly because *suttonii* nicely connects these more extreme species. The species is very closely related to *Plagiotrichus perdens* which occurs on two of the same oaks over much the same territory.

### *Plagiotrichus suttonii* variety *suttonii* (Bassett)

*Cynips* Q. *Suttonii* Bassett, 1881, Can. Ent., XIII, p. 54.

*Cynips suttonii* Packard, 1881, U.S. Ent. Comm. Bull., VII, p. 57. Riley (in Packard), 1890, 5th Rpt. U.S. Ent. Comm., p. 115.

*Andricus* (*Callirhytis*) *Suttoni* Mayr, Gen. Gallenbw. Cynip., p. 28. Ashmead, 1885, Trans. Amer. Ent. Soc., XII, p. 294.

*Callirhytis Suttonii* Ashmead, 1895, Trans. Amer. Ent. Soc., XII, p. 304.

Ashmead (in Packard) 1890, 5th Rpt. U.S. Ent. Comm., p. 105.

- Callirhytis Suttoni* Ashmead, 1887, Trans. Amer. Ent. Soc., XIV, p. 130.  
Ashmead (in Packard) 1890, 5th Rept. U.S. Ent. Comm., p. 110.  
Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 67.  
*Callirhytis suttonii* Beutenmuller, 1904, Bull. Amer. Mus. Nat. Hist., XX, p. 25. Thompson, 1915, Amer. Ins. Galls, pp. 7, 30.  
*Callirhytis quercus-suttoni* Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 564, 801.  
*Callirhytis suttoni* Felt, 1918, N.Y. Mus. Bull., 200, p. 60.

FEMALE.—Shows the following characters in addition to those common to all varieties of the species: Color generally darker rufous; first two segments of the antennæ almost black; mesonotum quite hairy; parapsidal grooves narrow but wider than in other varieties; anterior parallel lines not wholly smooth, extending not half way to the scutellum; mesopleuræ smooth and naked on only a small area beneath the tegulæ; hind coxæ brownish rufous to piceous; areolet very large; first abscissa of the radius sharply angulate, with a short spur; length 3.0-4.0 mm., averaging distinctly larger than in *suttonii*.

GALL.—Differs from the galls of the other varieties in being more robust, not as elongate as in *lustrior*, attaining a larger size, up to 60. mm. in diameter by 90. mm. long, fused galls reaching 115. mm. in diameter, usually much smaller. On *Quercus agrifolia*.

RANGE.—California: near San Francisco (Bassett); Oakland (types); Diablo (F. A. Leach collector); Carmel, Salinas, San Luis Obispo, Paso Robles, Gaviota, Santa Barbara. Restricted to a more northern part of the range of *Q. agrifolia*.

TYPES.—At the Philadelphia Academy of Natural Sciences, The American Museum of Natural History, the Museum of Comparative Zoology; and in the Beutenmuller collection (?). From near San Francisco, California; oak unknown; Wm. Sutton, collector. American Museum types are labelled Oakland.

Insects were emerging from galls I collected at Carmel on March 9, 1920.

The above descriptions are made from types, the coloring described from my material from Carmel. Old specimens, of several collections, are always faded a brighter rufous.

This variety is not very different from the more southern *polythyra* which also occurs on *agrifolia*. It is best distinguished by the larger areolet, the very sharply angulate first abscissa, and the larger size. I am not certain of the extent of the faunal area which includes *agrifolia* about San Francisco. The Santa Barbara insects are nearer this variety than *polythyra*, but do not have the first abscissa so sharply angulate.

**Plagiotrichus suttonii** variety **polythyra** (Kieffer)

*Callirhytis polythyra* Kieffer, 1904, Bull. Soc. Metz, (2), XI, p. 132; 1904 (in Baker), Invert. Pacif., I, p. 44. Dalla Torre and Kieffer, 1910, Das Tierreich, XXIV, pp. 586, 802, 825. Johnson and Ledig, 1918, Pomona College Journ. Ent. and Zoo., X, p. 25.

*Callirhytis quercus-suttoni* Fullaway, 1911 (in part), Ann. Ent. Soc. Amer., IV, p. 357.

**FEMALE.**—Shows the following characters in addition to those common to all varieties of the species: Color darker rufous; first two segments of the antennæ piceous black; mesonotum quite hairy; parapsidal grooves narrower than in *suttonii*, wider than in *lustrior*; anterior parallel lines not wholly smooth, extending not half way to the scutellum; mesopleuræ smooth and naked on only a small area beneath the tegulæ; hind coxæ brownish rufous to piceous; areolet moderately large; first abscissa of the radius very weakly angulate, almost without a spur; length 2.5-3.5 mm., averaging distinctly smaller than in *suttonii*.

**GALL.**—Differs from the galls of the other varieties in being robust, not as slender as in *lustrior*, reaching 30. mm. in diameter by 40. mm. in length, usually smaller. On *Quercus agrifolia*.

**RANGE.**—California: Claremont (Baker); Pasadena, El Toro. Restricted to a more southern range of *Q. agrifolia*.

**TYPES.**—At the Berlin Museum? Cotypes at Pomona College. Material from the same collector (Baker) and the same locality (Claremont) at Stanford University and The American Museum of Natural History.

Insects were already emerging from galls collected at Pasadena on February 22, 1920; some were still emerging on March 2.

Fullaway stated that Beutenmuller *in litt.* had pronounced *polythyra* and *suttonii* synonyms. I do not recall that the synonymy has been otherwise published. The two insects are very closely related, but *polythyra* differs in having a smaller areolet, a weakly angled first abscissa, and in being generally smaller; the ranges of the two are distinct, and the galls differ somewhat, mostly in size. The references to these varieties occurring on *Quercus chrysolepis* undoubtedly apply to *Andricus spectabilis* Kinsey, the gall of which resembles the gall of *suttonii*, altho the insects are generically very distinct.

**Plagiotrichus suttonii** variety **lustrior**, new variety

**FEMALE.**—Shows the following characters in addition to those common to all varieties of the species: Generally brighter rufous in color; first two segments of the antennæ distinctly rufous; mesonotum much less hairy than in the other varieties; parapsidal grooves more



narrow than in other varieties; anterior parallel lines posteriorly almost entirely smooth, extending more than half way to the scutellum; whole dorsal third of the mesopleuræ smooth and naked; all coxæ light rufous; areolet moderately large, sometimes smaller than in *polythyra*; first abscissa of the radius sharply angulate, with a short spur; length 2.5-3.2 mm., smaller than in any other variety.

GALL.—Similar to the galls of other varieties, but distinct in being elongate, rather regularly cylindrical, up to 15. mm. in diameter by 65. mm. in length. On *Quercus Wislizenii*.

RANGE.—California: Mt. Tamalpais, Byron.

TYPES.—20 females, 2 galls. Holotype female, paratype females, and gall at The American Museum of Natural History; paratype females and gall with the author; paratype females at the U.S. National Museum and Stanford University. Labelled Mt. Tamalpais, California; March 14, 1920; *Q. Wislizenii*; Kinsey collector.

Insects emerged at some date after collecting the galls on Mt. Tamalpais, on March 14, 1920. Galls collected a little further south, at Byron on March 19, showed all of the insects to have emerged earlier.

This variety clearly belongs to this species, but is very distinct from either of the *Quercus agrifolia* varieties. Host isolation has accomplished more in this instance than the geographic isolation of the *agrifolia* varieties.

I have a similar but shorter, generally smaller gall from *Wislizenii* in the San Bernardinos, and at Three Rivers; these probably represent one or two other varieties related to *lustrior*. A similar, still more elongate gall occurs on *Quercus Kelloggii*. This oak is very closely related to *Wislizenii*, and *lustrior* may sometimes occur on *Kelloggii*, but probably there are other related varieties which extend into northern California, Oregon, and the more northern range of the oak.

### Abnormal Galls of *Plagiotrichus suttonii*

GALL.—Very slender, elongate stem-swelling, rather irregular, but generally cylindrical, not over 8. mm. in diameter, but reaching 50. mm. in length. Internally quite solid, woody, with a more or less continuous, very irregular central cavity only incompletely divided into chambers; without distinct larval cells. On *Quercus agrifolia*, *Q. Wislizenii*, and *Q. Kelloggii*.

This gall occurs thruout the range of the varieties of *suttonii*. Nothing but inquilines is ever bred from it, and I take it to be the inquiline-inhabited gall of *suttonii*, just as inquiline-inhabited galls of *Diplolepis tuberculatrix* (Cockerell), of *Diplolepis bicolor* (Harris), and some others are dis-

tinct in structure. I cannot be certain that these are not abnormal galls of *Plagiotrichus perdens* (Kinsey), but I think not, for they never show a trace of the broken bark characteristic of *perdens*, and they occur on *agrifolia* which *perdens* does not appear to inhabit. The galls are very much alike on the three oaks. In general the insects emerge some weeks after the emergence of *suttonii* in the region.

I have these galls from *Quercus agrifolia* at Santa Barbara, Gaviota, Palo Alto, and Mt. Tamalpais; from *Q. Wislizenii* at Oakdale, El Portal, Merced Falls, Auburn, and Oroville; and from *Q. Kelloggii* at Descanso, Placerville, and Ukiah.

### **Trigonaspis ornata, new species**

**FEMALE.**—Almost wholly bright yellow rufous; antennæ distinctly slender; scutellum with a smooth depression at base; all wing veins heavy, including the cubitus. **HEAD:** Almost as wide as the thorax, eyes extending slightly beyond the cheeks; rufous yellow, tips of mandibles brown; finely rugose, only slightly more so on the face; sparsely hairy. Antennæ long, distinctly slender, light brown, the two basal segments straw yellow; finely pubescent; with 14 segments, the third slightly longer than the fourth, the last almost twice as long as the preceding. **THORAX:** Entirely bright yellow rufous; mesonotum almost smooth, shining, naked of hairs; parapsidal grooves prominent, deep, continuous to the pronotum, gradually convergent posteriorly, fairly proximate at the scutellum, widely divergent only finally at the pronotum; median groove, anterior parallel, and lateral lines lacking; scutellum somewhat elongate, rugose, hairy, a smooth, arcuate, fairly broad furrow at the base, only incompletely divided into foveæ; pronotum at the sides almost smooth, finely punctate and sparsely hairy; mesopleuræ rugose beneath the tegulæ, otherwise almost smooth, finely punctate and very sparingly hairy. **ABDOMEN:** Of the same bright yellow rufous as the thorax, darker to almost black ventrally; practically smooth, naked except for a few hairs latero-basally and on the posterior segments; longer than high, second segment not covering quite half the abdomen, not produced dorsally, ventral edges of all the segments well rounded, hind edges oblique. **LEGS:** Entirely clear yellow, tips of tarsi dark, finely hairy; tarsal claws heavy, toothed. **WINGS:** slightly yellowish; finely ciliate on the margins, veins heavy, rich, dark brown; areolet of moderate size; cubitus reaches the basalis; radial cell open, bounding veins not quite reaching the edge but extending parallel with it for a very short distance; second abscissa of the radius moderately curved; first abscissa heavy, strongly angulate, infuscated, the brown cloud extending along the subcosta and covering a small part of the base of the radial cell. **LENGTH:** 3.5 mm.

**MALE.**—Differs from the female as follows: Eyes larger, protruding distinctly on the sides, head wholly black except the yellow

piceous mandibles which are darker at the tip; antennæ with 15 segments, dark brown, tinged more rufous on the first two segments; thorax mostly piceous black, light piceous spots on the scutellum and mesopleuræ, most of scutellum smoother than in the female; abdomen rufous, very small, pedicellate; legs yellow rufous, the hind tibiæ and proximate segments of the tarsi brown; wings clearer, the infuscation at the base of the radial cell less than in the female; length 2.7-3.0 mm.

GALL.—Spindle-shaped, covered with a golden brown mass of short filaments; 6. mm. wide by 11. mm. long, widest slightly above the middle; distinctly tipped apically. Covered with a densely compacted mass of filaments, each filament short, wholly flattened with a slender, narrow blade 2. mm. long, the tips purplish when fresh. The central stem is swollen to form a thin-walled, empty larval chamber, apparently monothalamous. A bud gall, or on leaves, attached to the end of the mid-rib; on *Quercus breviloba*.

RANGE.—Texas: Austin (Patterson).

TYPES.—1 female, 5 males, and 3 galls. Holotype female, paratype male, and gall in The American Museum of Natural History; paratype males and galls at the U.S. National Museum and with the author. Labelled Austin, Texas, *Q. breviloba*, Patterson collection number 53.

The galls were collected March 3, and adults emerged April 15. In this country the genus has been known previously only from root galls, tho in Europe it is obtained from leaf and stem galls also.

The galls superficially resemble those of *Neuroterus evanescens* Kinsey, described in this paper, but the anthers in that gall are not particularly modified. The adult of this species closely resembles *Trigonaspis radicola* (Ashmead); the female of *ornata* differs in being more brilliant rufous in color, slightly smaller, the antennæ are distinctly more slender, the scutellum is less rugose with the basal depression smooth (rugose in *radicola*), and the wing veins are much heavier, even the cubitus being heavy (quite faint in *radicola*). A further study of material from more localities and hosts may show that this is a variety of *radicola*, which occurs on *Q. alba*, and was first described from Missouri. *Ornata* will prove a distinct variety at least.

The connection of *ornata* and *radicola* prompts a suggestion concerning the life history of the species, which though resting on circumstantial evidence, may be hazarded if it is taken only as an hypothesis. Brodie (1896, Ann. Rpt. Clerk Board Forestry, Ont., pp. 114-116) records *Biorhiza forticornis* ovipositing on the rootlets of *Q. alba*. In a 1920 paper (Bull. Amer. Mus. Nat. Hist., XLII, p. 374), I recorded the

observation of *Biorhiza forticornis* (which is wingless, agamic, coming from terminal twig galls on *Q. alba*) ovipositing in December at the roots of *Q. alba*. I have observed galls of *Trigonaspis radicola* on the roots of trees which bore old galls of *forticornis*, and recently Weld (Proc. U. S. Nat. Mus., LIX, pp. 203-204) notes thirty-six instances of coincidence of the two galls on trees of *Q. alba*. There is considerable circumstantial evidence, then, of the cyclic alternation of *Biorhiza forticornis* and *Trigonaspis radicola*. In the paper above mentioned I further described a March brood of *forticornis*, obtained from the same galls as the December brood, ovipositing in the terminal buds of the tree; no galls were obtained from these buds in the experiments. Is it possible that the *ornata* gall (or more probably a similar variety on *Q. alba*) is the bud gall from eggs of the March brood of *forticornis*? Are there two interlocking cycles in the life of this species? What is the solution of the heredity questions presented? Such are the alluring problems to be solved only after the cycle has been experimentally investigated.



# Varieties of a Rose Gall Wasp (Cynipidæ, Hymenoptera)<sup>1</sup>

By ALFRED C. KINSEY and KENNETH D. AYRES

The following is a study of the varieties of *Diplolepis tuberculatrix* (Cockerell), based largely on material collected by the senior author during the spring of 1920, while he was a Sheldon Travelling Fellow of Harvard University. We have almost exactly four thousand insects of *tuberculatrix*, and some thousands of galls. In spite of which there remains much work to be done, for we do not yet have material from the majority of the more or less distinct faunal areas of the parts of western United States probably covered by the species. Many additional varieties should be disclosed.

The merits of our conception of a single species with many varieties are emphasized by the serious confusion in the bibliographic synonymies of previously described forms. It has never been possible to separate material by means of the scanty descriptions available; always the descriptions ignored the distinctive characters concerned. Considering that distinct species alone were the only concerns, some synonymy was introduced for very similar material, making the utilization of existing data more difficult.

Each variety as far as known is confined to a faunal area stamped as distinct by parallel distributions of other Cynipidæ, of other insects, and of plants to some degree. Within each area individuals vary as do all individual objects, but nevertheless are most remarkably uniform. The limits of the range of each variety are not often crossed by other varieties; at the meeting points of two forms, the two remain distinct, without the occurrence of the traditional intermediates. Witness *xerophila* and *wasatchensis*. Geographic isolation is an accompaniment of the occurrence of distinct varieties in this species, whether or not we care to consider it the cause.

There can be no doubt of the specific unity of this group. The females are separated on relatively few characters, the males are still more difficult to distinguish, if indeed it can

<sup>1</sup>Contributions from the Zoölogical Laboratories of Indiana University No. 194 (Entomological No. 3).

be done in every instance. The galls indicate closely similar physiologies for all varieties, but in most cases can be distinguished. Where the insects show closest relations then the galls are most similar! This is the case with a series comprising varieties *tuberculatrix*, *similis*, *arefacta*, and *coloradensis*; similarly with a series leading from *coloradensis* to *tumida* and *wasatchensis*; again with a series including *californica versicolor*, and *melanderi*; and with the distinct and compact series of *rubriderma*, *sierranensis*, and *descansonis*. These more closely related varieties might be considered in groups as subspecies if we had occasion to use the terminology.

In such series of varieties the developments of characters appear to proceed in a continuous, geographic direction, as is discussed under *sierranensis*. Orthogenesis and other frightful words loom large, but need further investigation.

Two of these series of species present the curious situation of ranges which cross, as we explain further under *sierranensis*.

This species alone will serve to decide the validity of Kieffer's term, *Lytorhodites* Kieffer (1902, Bull. Soc. Metz, (2), X, p. 96). This genus was established to include species of *Dipolepis*, "*Rhodites*", which show a scutellum without foveæ, the abdomen microscopically reticulate, and the radial cell more or less open. There is certainly no correlation between the occurrence of these characters among species of rose gall makers, and the nature of the radial cell has been the single character used to delimit the genus. *Arefacta*, one of the varieties of the present species, is type of the genus (designated by Rohwer and Fagan, 1918, Proc. U.S. Nat. Mus., LIII, p. 370). In this species, *tuberculatrix*, occur varieties with the radial cell of the female regularly open; in several other varieties, such as *californica*, individuals have the cell either open or closed, usually closed. Sometimes a single individual will present different conditions on the two wings, that is, belonging to one genus on one wing, to another on the other wing! The males of several of the varieties have the radial cell always closed. This, in connection with the entire lack of other correlated characters for the genus, confirms our previous surmise (Kinsey, 1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 392) that *Lytorhodites* cannot be maintained as a genus distinct from *Dipolepis*.

Of 4,060 individuals bred, 1,858, or about 46 per cent are

males. It is difficult to obtain complete data on the ratio of the sexes, for the males appear to emerge regularly somewhat earlier than the majority of the females (see *xerophila*, *wasatchensis*, *californica*, *rubriderma*, and *descansonis*). If the galls are collected too early it appears to reduce the number of females emerging, probably by serving to kill the individuals less developed at the time of collecting. All of the galls collected after emergence had proceeded to some degree gave a reduced number of males. It is probably safe to assume that the sexes occur in about equal numbers.

With the sexes so nearly equal, fertilization probably occurs regularly. Whether parthenogenetic development ever occurs would be a matter of interest in connection with the regularly or at least usually parthenogenetic development of some species of the same genus (see Kinsey, 1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 393). No species in the genus is known to exhibit an alternation of generations, and the field data for this species would not suggest the occurrence of that phenomenon. The insects overwinter as larvæ, pupating only a very short time before emergence, emerging as adults in early spring, mostly before February 23 on the southern boundary of California, to April 22 and later at the higher elevations in Colorado, and July 27 in southern Montana, (according to Ashmead, for variety *similis*). New galls probably begin development about a month after the emergence and oviposition of the insects. This biologic data is remarkably uniform for all varieties of the species, differing merely in dates of emergence as affected by the earlier or later arrival of spring at more southern or more northern localities.

While red is the normal color of the female, several of the varieties have some of the females black. The heredity problems involved here deserve further study. See our data under variety *coloradensis* form *subcoloradensis*.

Inquiline-inhabited galls of this species present a considerable modification which has resulted in their consideration as distinct species. This is discussed at the end of the paper.

### **Diplolepis tuberculatrix (Cockerell)**

FEMALE.—Rufous or black; thorax finely, irregularly roughened; parapsidal grooves continuous; median groove usually evident; scutellum without foveæ; radial area only slightly shaded. HEAD: As wide as the thorax, not broadened behind the eyes; very finely rugose on the

front, more rugose and punctate on the face; covered with fine hairs. Antennæ with 14 (or 15) segments; second segment globose, the third distinctly longer than the fourth, the last almost twice the length of the preceding, or incompletely divided. THORAX: Finely, irregularly roughened, finely punctate and covered with fine hairs; parapsidal grooves distinct but not deep, rather widely separated at the scutellum, continuous to the pronotum; median groove of variable length; anterior parallel lines smooth, not at all prominent, extending less than one-half the distance from the pronotum to the scutellum; lateral lines fine, smooth; mesopleuræ smooth, with an irregularly rugose area dorsally, and a rugose, transverse band two-thirds toward the ventral edge; scutellum irregularly, finely rugose, covered with fine hairs, a transverse, rugose groove at base not forming foveæ. ABDOMEN: Shining, naked, completely, finely reticulate; distinctly elongate; second segment covering less than one-third the whole abdominal area, the edge somewhat oblique, only moderately rounded ventrally; segments behind the second sparsely fringed with fine hairs; ventral sheath plow-shaped, spine short, blunt. LEGS: Punctate and covered with fine hairs; claws simple. WINGS: Set with fine hairs; very short ciliate; veins dark brown, rather heavy; areolet of variable size; cubitus continuous but fine at the basalis, or discontinuous; radial cell short, open in most varieties, but often with a more or less heavy brown shading along the margin; a slight shading of brown covering the whole radial area and parts bordering it; first abscissa of the radius arcuate to angulate with occasionally a prolonged but more or less detached projection into the radial cell. LENGTH: 2.5 to 4.3 mm.

MALE.—Differs from the female as follows: Head black except the dark rufous mouthparts; antennæ wholly black or with the first three segments rufo-piceous; with 14 or 15 segments, the third twice the length of the fourth, slightly curved, the last longer than the preceding or incompletely divided; thorax black or tinged with rufous in places; abdomen black, very small; legs rufous, the hind coxæ more or less piceous; wings shaded not so heavily as in the female, the radial area open or often closed; length 1.5-3.0 mm.

GALL.—Good-sized, irregularly rounded, more or less spiny twig gall. Polythalamous, with many larval cells. Of variable size, up to 50. mm. in diameter, or of greater length, usually smaller. Very irregular in shape, most often globose or elongate, arising more or less abruptly from the stem; covered with a thin and partly deciduous bark; green, tinged with pink when young, reddish or dull purplish brown when mature, light brown in some varieties, darkening with age; entirely smooth, or covered with a few, stout spines, or with slender, even moss-like, close-set spines. Internally solid, more or less compact with soft, whitish tissue, the larval cells elongate, lying irregularly, more toward the center of the gall. Terminally, laterally (on a lateral twig), or along a continuous stem; on *Rosa* spp.

RANGE.—Illinois and Wisconsin to New Mexico, southern California, and Washington.



**Diplolepis tuberculatrix variety tuberculatrix (Cockerell)**

*Rhodites tuberculator* Cockerell, 1888, West Amer. Sci., IV, p. 60; 1890, Ent., XXIII, p. 75; 1900, Ent. Student, I, p. 10. Ashmead, 1890, Colo. Biol. Assoc. Bull., I, p. 38. Gillette, 1892 (in part), Ent. News, III, p. 247. Beutenmuller, 1907 (not the Utah record, not the figs.), Bull. Amer. Mus. Nat. Hist., XXIII, p. 641. Felt, 1918 (not the figs.), N.Y. Mus. Bull., 200, p. 146.

**FEMALE.**—Differs from the female of other varieties as follows: Color generally dark rufous brown to rufo-piceous; antennæ black with the first three segments rufous; median groove distinct for more than two-thirds the mesonotal length; scutellum rufo-piceous, a brighter rufous area centrally; abdomen rufo-piceous, in part blackish; areolet of moderate size; first abscissa of the radius slightly angulate, sometimes with a very short but distinct projection; radial area open; length 3.0-3.7 mm.

**MALE.**—Very similar to the males of other varieties; wholly black; median groove distinct for two-thirds the mesonotal length; areolet moderately large; radial area open; length 3.2 mm.

**GALL.**—Very similar to the galls of the other varieties; relatively small, smooth, more free of spines.

**RANGE.**—Colorado: West Cliff, Colorado Springs (Cockerell); Manitou (Kinsey). Records from other regions of Colorado, or from other states, very probably do not apply to this variety.

**TYPES.**—Not located. Type locality is West Cliff, Colorado.

The above description was made from an adult from material collected at Colorado Springs by Prof. Cockerell, and from the insects and galls collected at Manitou. This variety is probably restricted to a region in Colorado on the east of the Continental Divide, but we do not have material enough to determine the limits of the distribution. Utah galls, figured by Beutenmuller, and refigured by Felt, belong to variety *tumida*.

**Diplolepis tuberculatrix variety similis (Ashmead)**

*Rhodites similis* Ashmead, 1896, Proc. U. S. Nat. Mus., XIX, p. 136. Cockerell, 1900, Ent. Student, p. 10. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 79; 1910, Das Tierreich, XXIV, pp. 715, 841. Thompson, 1915, Amer. Ins. Galls, pp. 22, 45.

*Rhodites arefactus* Beutenmuller, 1907 (in part), Bull. Amer. Mus. Nat. Hist., XXIII, p. 641, pl. XLV, figs. 2-4. Felt, 1918 (in part), N.Y. Mus. Bull., 200, fig. 151 (3, 4).

**FEMALE.**—Is distinguished from other varieties of the species as follows: Head rufous brown with dark shading between the compound eyes and the mouthparts, and dark shading on the vertex and the posterior side of the head; first three segments of the antennæ light

rufous brown, the remaining segments brownish black; thorax rufous brown, finely punctate, sparsely covered with hairs; median groove very distinct, extending to the pronotum; mesopleuræ black with the smooth central area rufous; abdomen rufous; areolet moderately small; cubitus apparently continuous; first abscissa of the radius arcuate-angulate; radial cell open, shaded with brown; length 3.7 mm.

MALE.—From the original description, would appear to be similar to the males of the other varieties except in having the basal segments of the antennæ rufous brown.

GALL.—Very similar to the galls of most other varieties; relatively smooth and spineless, small.

RANGE.—Wyoming (=Montana?): Point of Rocks (Bruner coll.).

TYPES.—Adults (and galls?) at the U.S. National Museum, No. 3098; cotype galls at The American Museum of Natural History. From Point of Rocks, Wyoming; Bruner collector.

Ashmead's material was reared July 27.

These redescriptions are made from type females loaned by the U.S. National Museum, and from type galls in The American Museum of Natural History. The variety is closely related to variety *tuberculatrix*, tho the two are distinct. Beutenmuller considered *similis* a synonym of *arefacta*, which it does closely resemble. But the type localities of the two are about 450 miles apart, in the very discontinuous country of the northern Rocky Mountains, where the quantity of barren areas serves to isolate many distinct varieties. Until we can see an abundance of material from both regions it would be very unwise to bury and confuse data by maintaining the synonymy. These varieties show closest relations to the varieties west of the Continental Divide and in Utah.

### *Diplolepis tuberculatrix* variety *arefacta* (Gillette)

*Rhodites arefactus* Gillette, 1894, Can. Ent., XXVI, p. 157. Cockerell, 1900, Ent. Student, I, p. 10. Beutenmuller, 1907 (in part), Bull. Amer. Mus. Nat. Hist., XXIII, p. 640, pl. XLV, fig. 1. Thompson, 1915, Amer. Ins. Galls, pp. 22, 45. Felt, 1918, N.Y. Mus. Bull., 200, p. 146, fig. 151 (1). Kinsey, Bull. Amer. Mus. Nat. Hist., XLII, p. 391.

*Lytorhodites arefactus* Kieffer, 1902, Bull. Soc. Metz, X, p. 97. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 79; 1910, Das Tierreich, XXIV, pp. 723, 840. Fullaway, 1911, Ann. Ent. Soc. Amer., IV, p. 378.

FEMALE and MALE.—Apparently similar to variety *similis*.

GALL.—Described as small and spineless.

RANGE.—Colorado: Fort Collins (Gillette). Records from other regions of this state and from other states apply to other varieties.

TYPES.—In the C. P. Gillette collection (?), the U.S. National Museum (?), and at The American Museum of Natural History.

Gillette bred adults in late March. We have not yet seen type material of this variety, nor material from the type locality. Our reasons for considering this distinct from *similis* are detailed under that variety.

### **Diplolepis tuberculatrix variety multispinosa (Gillette)**

*Rhodites spinosissima* Gillette, 1889, Iowa Exp. Sta. Bull., VII, p. 244, fig. 28 (name pre-occupied).

*Rhodites multispinosa* Gillette, 1890, Ent. Amer., VI, p. 25, fig. 2; 1892, Proc. Iowa Acad. Sci., I, p. 110, pl. II. Thompson, 1915, Amer. Ins. Galls, pp. 22, 45.

*Rhodites multispinosus* Dalla Torre, 1893, Cat. Hymen., p. 127. Beutenmuller, 1907 (except Ontario and Washington records), Bull. Amer. Mus. Nat. Hist., XXIII, p. 642, pl. XLV, figs. 11, 12, pl. XLVI, fig. 1. Washburn, 1918, 17th Rpt. State Ent. Minn., p. 180. Felt, 1918, N.Y. Mus. Bull., 200, p. 146, figs. 150 (1), 151 (11, 12). Kinsey, 1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 391.

*Lytorhodites multispinosus* Kieffer, 1902, Bull. Soc. Metz, X, p. 97. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 79; 1910, Das Tierreich, XXIV, pp. 722, 839.

(*Rhodites multispinosus* of Jarvis, Cosens, and Stebbins, is *Diplolepis dichlocera* (Harris).)

FEMALE.—Apparently (from the description) differs from other varieties as follows: General color rufous, with some black below the eyes and about the ocelli; median groove extending two thirds to the pronotum; abdomen dark rufous, black on the ventral valve; areolet large; radial cell open; length 4.3 mm.

MALE.—Apparently very similar to the male of other varieties; length 2.5 mm.

GALL.—Similar to the gall of other varieties, more or less densely covered with spines, more so than in other varieties, these breaking off with age and wear.

RANGE.—Illinois: Ft. Sheridan, Evanston (Weld). Wisconsin: Milwaukee (Brues in Beutenmuller). Minnesota: Minneapolis (Potter in Mus. Comp. Zool.); Cass Lake (Washburn). Records except from adjacent parts of the north Middle West apply to other varieties.

TYPES.—1 female at the Philadelphia Academy; the types at the Iowa State College cannot be located. Originally collected in Minnesota.

Insects have been bred in late June (Weld) and early July.

The gall of this variety is distinctive, altho individual galls may not always be characteristic. We have very little of this material in our collection.

Beutenmuller suggested that "*multispinosus* may prove to

be the same as *R. tuberculator* Cockerell" (Bull. Amer. Mus. Nat. Hist., XXIII, p. 643) ; the two are varieties of one species, but distinct.

**Diplolepis tuberculatrix** variety **coloradensis**, new variety  
form **coloradensis** new form

**FEMALE.**—Is distinguished from the other varieties of the species as follows: General color bright rufous, brighter than in variety *tuberculatrix*; head bright rufous with small dark patches between the compound eyes and the mouth; first three or four segments of the antennæ bright rufous, remaining segments black; thorax light rufous; median groove not deep but extending well toward the pronotum, distinctly longer than in *xerophila*; scutellum almost evenly bright rufous; mesopleuræ rufous, edged black; abdomen bright rufous, darker terminally; first abscissa of the radius angulate; cubitus hardly continuous; radial cell distinctly open; areolet moderately large, larger than in variety *tuberculatrix*; length 2.5-4.0 mm., averaging larger than in variety *tuberculatrix*, but distinctly smaller than in *tumida*.

**MALE.**—Differs from the male of other varieties as follows: Almost wholly black except on the mouthparts; median groove extending well forward; areolet of moderate size; cubitus not continuous; radial cell mostly open; length 2.0-3.5 mm.

**GALL.**—Very similar to the galls of other varieties; dark purplish brown, mostly smooth, with a few, scattered, moderately short spines; many of the galls are unusually small, tho some of them measure up to 28. mm. in diameter.

**RANGE.**—Colorado: Glenwood Springs.

**TYPES.**—62 females, 90 males, and 33 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Glenwood Springs, Colorado; April 22, 1920; Kinsey collector.

The characters of this variety are intermediate between those of varieties *tuberculatrix* and *tumida*, which range in either direction from Glenwood Springs, but series of individuals do not show variation toward other varieties. The type locality is in a rugged mountain region, with many barren peaks, and desert and alkaline plateaus, lying west of the high elevations of the Continental Divide. In such a country a host of distinct varieties may well be isolated. The most interesting phenomenon shown by the variety is the common occurrence of a black form; this is described in the next paragraphs. Because of the identity of the males of the two forms, we have not been able to assign individuals of that



sex to either form definitely except when they were cut from the galls. Of a total of 185 adults bred from both forms, 94, or just about one-half were males. Most of the adults had not emerged on April 22.

**Diplolepis tuberculatrix variety coloradensis**  
form **subcoloradensis**, new form

FEMALE.—Differs from form *coloradensis* only in being generally black; sometimes with some rufous, especially from the base of the antennæ to the mouth, and about the ocelli, on the first three segments of the antennæ, on the smooth area of the mesopleuræ, and centrally on the scutellum; abdomen often with a rufous tinge.

MALE.—Quite identical with the male of form *coloradensis*.

GALL.—Quite identical with the gall of form *coloradensis*.

RANGE.—Colorado: Glenwood Springs.

TYPES.—29 females, 4 males, 4 galls. Holotype female, paratype adults, and gall at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, and with the author. Labelled Glenwood Springs, Colorado; April 22, 1920; Kinsey collector.

This black form and the red form of *coloradensis* are identical in structure, and the galls, an indication of the insect physiology, are quite the same. There can be no doubt that the two represent a single variety. Of 91 females obtained from Glenwood Springs, 29 are mostly black. These individuals are usually entirely black altho we obtained several degrees of intermediates between rufous and black. Up to date we have obtained only red or only black insects from a single gall. We have obtained both sexes of the black form, and presumably both sexes of the red form. It is to be noted that black is the color of the males of all varieties of the species, being therefore normally connected with sex inheritance. Reproduction in the genus may be from fertilized eggs or parthenogenetically. These facts may be concerned with the occurrence of the black form. We are instituting further investigations with this material to try to determine what peculiar heredity phenomena may be concerned here. Black females occur occasionally in several other varieties of this species, tho not as abundantly as we have found it in *coloradensis*. We find black individuals in variety *melanderi* and in *californica*, tho all degrees of melanism are to be found with the latter variety, and the normal female there contains much black; *tumida* is a black form of a Utah species.

**Diplelepis tuberculatrix variety tumida**  
**form tumida (Bassett)**

*Rhodites tumidus* Bassett, 1890, Trans. Amer. Ent. Soc., XVII, p. 60. Cockerell, 1900, Ent. Student, I, p. 10. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 79; 1910, Das Tierreich, XXIV, pp. 720, 841. Beutenmüller, 1904, Bull. Amer. Mus. Nat. Hist., XX, p. 23; 1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 639, pl. XLV, figs. 5-7. Thompson, 1915, Amer. Ins. Galls, pp. 22, 45. Felt, 1918, N.Y. Mus. Bull., 200, p. 146, fig. 151 (5-7).

FEMALE.—Differs from the female of form *xerophila* only in being almost wholly black, the abdomen tinged rufo-piceous.

MALE.—Identical with the male of form *xerophila*.

GALL.—Identical with the gall of form *xerophila*.

RANGE.—Southern Utah (Siler coll.).

TYPES.—Adults and galls, at the Philadelphia Academy and The American Museum of Natural History.

We have examined Bassett types, and find this form identical with the following form except in the color of the female. We have a black form of variety *coloradensis*, and black individuals in *melanderi* and *californica*, but have failed to obtain the black form for this variety, altho we bred almost 3,300 of the insects. It appears that by a curious coincidence Bassett obtained only the abnormal, less common form of the variety. The red form has not previously been described, and since the red is the normal form our notes on this variety are given under *xerophila*.

**Diplelepis tuberculatrix variety tumida**  
**form xerophila, new form**

*Rhodites tuberculator* Beutenmüller, 1907, Bull. Amer. Mus. Nat. Hist., XXIII, pl. XLV, figs. 8-10. Felt, 1918, N.Y. Mus. Bull., 200, fig. 151 (8-10).

FEMALE.—Is distinguished from other varieties of the species as follows: Color generally bright rufous with some black; head rufous with small black patches on either side between the mouth and the compound eyes; antennæ with the first three segments rufous, the remaining segments black; thorax rufous, very distinctly more elongate than in *wasatchensis*, without a median depression anteriorly as in *wasatchensis*; parapsidal grooves distinctly broader and more rugose than in *coloradensis*, broader and less rugose than in *wasatchensis*; median groove distinct, extending two-thirds the distance to the pronotum, distinctly shorter than in *coloradensis*, possibly less distinct than in *wasatchensis*; mesopleuræ bright rufous bordered with black; scutellum rufous; abdomen bright rufous, darker terminally; first abscissa of the radius an-

gulate but without a projection into the radial cell; areolet of moderate size, larger than in *coloradensis*, smaller than in *wasatchensis*; radial cell distinctly open; length 3.5-4.5 mm., averaging larger than in *coloradensis*.

MALE.—Differs from the males of other varieties as follows: Wholly black, often tinged dark rufous in spots, especially about the head; parapsidal grooves wider and more distinct than in the male of *wasatchensis*; median groove distinct, extending two thirds to the pronotum; areolet moderately large; radial area entirely open; length 2.7-4.0 mm.

GALL.—More or less similar to the galls of other varieties, decidedly smoother than in any others, with rarely a few short, rather stout spines; more often elongate than in any others; green, touched with rose when young, becoming light olive brown and light brown with age.

RANGE.—Utah: Green River, Price, Provo.

TYPES.—99 females, 132 males, 70 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Green River, Utah; April 21, 1920; Kinsey collector.

The galls figured by Beutenmuller as *tuberculator*, refigured by Felt, were collected in Utah by Uhler in the spring of 1881, and are characteristic of this variety.

Of 3,283 individuals bred, 1,535, or about 47 per cent, are males. Material collected on April 18 at Provo, where many adults had already emerged, gave only 28 per cent males; galls collected on April 20, at Price, where a few adults had previously emerged, gave 42 per cent males; galls collected April 21 at Green River, where most of the insects were still larval, gave 55 per cent males. Note that the two later collections were of less mature galls, for these localities are at a much higher elevation! The considerable differences in sex ratios from the different localities were very probably due to the males emerging mostly before the females emerge. The insects live thru the winter as larvæ, pupating only a very short time before emergence in late April. Emergence dates must be affected considerably by the development of the season at the different elevations.

This variety is intermediate between *coloradensis* and *wasatchensis*, just as its geographic position is intermediate. Of the 255 Green River individuals examined in minute detail, none show variation toward any other variety. The Price and Provo material varies more. In regard to the nature of the parapsidal grooves, which is one of the best single characters to distinguish these varieties, we have these data: Of

255 Green River adults all of them have the grooves of *xerophila*; of 674 individuals from Price, fifty miles nearer the *wasatchensis* type locality, 20, or 3 per cent, fail to show the parapsidal grooves characteristic of *xerophila*, but in no case are the grooves those of *wasatchensis*; of 156 individuals from Provo, another sixty miles nearer the *wasatchensis* locality, but still almost one hundred miles removed, 12, or about 8 per cent, do not have *xerophila* grooves, but only 2 of these are distinctly *wasatchensis*. Here is an instance of two varieties having adjacent, not well isolated ranges, being remarkably pure at more extreme localities, remaining remarkably pure even where the ranges of the two overlap. It will be highly profitable to make more elaborate studies of the variations of these varieties at other points.

The galls of the two varieties are quite distinctive; there is no great variation in our material from either of the type localities, tho the Provo and Price material shows more variation. These galls however more closely resemble the *xerophila* galls, again emphasizing the nice measure the gall is of the specific and varietal nature of the insect.

All of these localities are more or less isolated geographically. Green River is located on a very alkaline and barren plateau, about 5,000 feet high, distant from the next locality likely to grow roses. Price is similarly located. Provo lies at a lower elevation, on the edge of the desert, in the fertile territory which lies more or less continuously, depending on the location of the mountain streams which come out onto the desert, along the base of the Wasatch mountains as far north as Brigham, the type locality of *wasatchensis*. Here is an interesting instance of geographic isolation effecting sometimes more but sometimes less absolute segregation of varieties.

### **Diplolepis tuberculatrix variety wasatchensis, new variety**

FEMALE.—Is distinguished from other varieties of the species as follows: General color rufous; head rufous with a large black patch between the mouth and the compound eyes, extending to the bases of the antennæ; antennæ with first three segments rufous, remaining segments black; thorax distinctly broader than in *xerophila*, medianly depressed anteriorly between the anterior parallel lines; the parapsidal grooves not as broad but more rugose than in *xerophila*; median groove distinct, extending two-thirds the distance to the pronotum; mesopleuræ bright rufous, edged with black; abdomen dark rufous; first abscissa of



the radius rather heavy, angulate but without a projection or with a very slight projection into the radial cell; areolet very large, larger than in *xerophila*; cubitus distinctly discontinuous; radial cell open; length 3.0-4.0 mm.

MALE.—Very similar to the males of other varieties, differing as follows: Parapsidal grooves very narrow, often indistinct or discontinuous; median groove distinct, extending two-thirds the distance to the pronotum; areolet large; cubitus discontinuous; length 2.5 mm.

GALL.—Very similar to the galls of most varieties; generally smaller, smooth, dark purplish brown, practically spineless.

RANGE.—Utah: Brigham, Provo.

TYPES.—40 females, 11 males, 20 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Brigham, Utah; April 16, 1920; Kinsey collector.

Of 55 individuals bred from galls collected April 16, 1920, only 22, or 20 per cent, are males. This was probably due to the males emerging mostly before the females.

This variety comes very close to *xerophila*, but is distinct in the nature of the parapsidal grooves, the breadth of the thorax, and the nature of the gall, as well as in the means of other characters. A discussion concerning the distinctness of this variety is given under *xerophila*.

### **Diplolepis tuberculatrix variety californica (Beutenmuller)**

*Rhodites arefactus* Cook, 1910, Mich. Geol. and Biol. Surv., I, p. 25 (error, the California record applying probably to this variety).

*Rhodites californicus* Beutenmuller, 1914, Bull. Brooklyn Ent. Soc., IX, p. 88, pl. V, figs. 11-13. Felt, 1918, N.Y. Mus. Bull., 200, p. 144.

FEMALE.—Is distinguished from other varieties of the species as follows: General color dark rufous with some black, varying to wholly black, usually very dark rufous to black; mouthparts and a small area around the ocelli dark rufous; first and third segments of the antennæ brownish rufous, the second segment brown, remaining segments black; thorax usually dark rufous with the lateral lines and the anterior half of the area between the parapsidal grooves black; median groove not prominent, extending only a very short distance from the scutellum; mesopleuræ edged with black, with a dark rufous central area; scutellum dark rufous; abdomen light rufous anteriorly, approaching black postero-ventrally; wing veins unusually heavy; areolet moderately large or large; radial cell and surrounding area well shaded with brown; radial cell more or less closed; first abscissa of the radius unusually heavy, angulate with an indication of a projection into the radial cell; length 3.0-4.0 mm.

MALE.—Very similar to the males of other varieties, differing as follows: Median groove not distinct but extending about one-half the distance to the pronotum; areolet of medium size; radial cell more or less completely closed; length 2.2-3.2 mm.

GALL.—Of exactly the same type as that of most varieties, large, and when fresh covered with a dense, mossy mass of spines, filaments, and aborted leaves, this covering deciduous with age and wear but leaving the gall thickly studded with the bases of broken spines and filaments.

RANGE.—California: Berkeley (Beutenmuller); Santa Rosa, Palo Alto, Salinas. Probably occurs thruout central California, the "Californian" zone.

TYPES.—In the Beutenmuller collection, the Museum of Comparative Zoology, the Philadelphia Academy, the U.S. National Museum, Stanford University, and the British Museum. Collected at Berkeley, California, by E. C. Van Dyke.

Of 37 adults we have bred, 13, or 35 per cent, are males. Beutenmuller bred adults in February and March. Galls we collected at Salinas on March 8 had had the insects emerge previously, tho some of the galls were still fresh and green, probably indicating that the gall makers had emerged only recently. Galls collected at Palo Alto on March 13 had only a few adults emerge later; from Santa Rosa galls of March 16 a larger number of adults emerged, illustrating again the fact that in regions of later seasons emergence dates are later. The low number of males obtained is very probably due to the fact that the females are the last to emerge, and were in the majority at the dates when we collected.

Beutenmuller's material was sent by Van Dyke from Berkeley, but the rose host had been transplanted from the San Jacinto Mountains in southern California. We have material from the San Jacinto Mountains; it is of another and rather unrelated variety, *sierranensis*. The types of *californica* well match our material collected in localities not so distant from Berkeley. There is no evidence that *sierranensis*, transported to Berkeley, would become *californica*. The type material then represents a variety native to central California. The nearest relative is variety *versicolor* from eastern Oregon, and less directly related is variety *melanderi* from eastern Washington. Altho our Santa Rosa material is distinctly *californica*, it averages generally blacker, with some individuals largely (but never entirely) black, emphasizing local constancy with continual variation between localities.

**Diplolepis tuberculatrix variety versicolor, new variety**

**FEMALE.**—Is distinguished from the other varieties of the species as follows: General color rufous brown with black, the rufous distinctly darker than in *californica*; head black, with a narrow, rufous brown patch extending from the bases of the antennæ to the mouth and with a rufous brown patch extending from the borders of the eyes upwards and covering the vertex at both sides and behind the ocelli; first three segments of the antennæ brown to black, remaining segments black; thorax rufous brown with the anterior parallel lines and lateral lines rufous to black (generally darker than the remainder of the thorax); median groove evident only a short distance from the scutellum; anterior parallel lines quite distinct; mesopleuræ black with a rufous central area; scutellum dark rufous to brown; abdomen rufous anteriorly, shading into black posteriorly; areolet moderately small; first abscissa of the radius angulate without a projection; cubitus apparently continuous; radial cell distinctly open; length 3.0 to 4.0 mm., but of a distinctly smaller build than *californica*.

**MALE.**—Not available for description.

**GALL.**—Closely resembles that of *californica*.

**RANGE.**—Oregon: La Grande. Probably occurs thruout Oregon east of the lava bed elevations, and in adjacent parts of Idaho.

**TYPES.**—6 females, 9 galls. Holotype female, paratype galls at The American Museum of Natural History; paratype females and galls at Stanford University, the U.S. National Museum, and with the author. Labelled La Grande, Oregon; April 12, 1920; Kinsey collector.

Collections at La Grande on April 12, 1920, showed all of the males emerged, and only a few of the females were still in the galls. The females, as with other varieties, appear to emerge somewhat later than the males. This variety is most closely related to *californica*. It occurs in a barren country which is entirely separate from western Oregon, and distinct from central California where *californica* occurs.

**Diplolepis tuberculatrix variety melanderi, new variety**

*Rhodites multispinosus* Beutenmuller, 1907 (error; Washington record only), Bull. Amer. Mus. Nat. Hist., XXIII, p. 642.

**FEMALE.**—Is distinguished from the other varieties of the species as follows: Head dark rufous to black, sometimes with a darker band between either compound eye and the mouth and with lighter areas between the mouth and the bases of the antennæ and on the vertex; first three segments of the antennæ dark rufous brown, remaining segments black; thorax dark rufous, shading toward black, or almost wholly black; median groove rather distinct for one-half the distance to the pronotum; scutellum dark rufous, darker on the edges; mesopleuræ black, usually with a rufous central area; abdomen dark rufous shading

to dark brown or black at the posterior end; areolet of only moderate size; cubitus apparently continuous; first abscissa of the radius distinctly angulate; radial cell at least in part open; length 3.5-4.2 mm.

MALE.—Very similar to the males of other varieties; median groove extending one-half the distance to the pronotum; abdomen with a decidedly rufous tinge; areolet of only moderate size; radial area closed; length 2.2-3.5 mm.

GALL.—Similar to that of *californica*, but the spines are all rigid, not so dense, often rather sparse, and the filamentous and leafy covering of *californica* is lacking.

RANGE.—Washington: Pullman (Melander). Probably confined to the small and distinct region about the Cœur D'Alene and Moscow mountains of the Idaho and Washington border.

TYPES.—4 females, 8 males, 3 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and gall with the author. Labelled Pullman, Washington; Melander collector; American Museum numbers 24634, 24636, 24645, and 24663.

Structurally this variety is very closely related to *californica* and *versicolor*, but in *melanderi* the median groove is decidedly longer than in either of the others; the more rufous specimens of *melanderi* are much lighter and the more black specimens are much darker than in *californica*, while the intermediates do not show the distribution of rufous and black characteristic of *californica*. The gall shows distinct relations to the gall of *californica*, but is spiny rather than mossy; this spinous gall resembles the gall of *multispinosa*, leading to Beutenmuller's mistake in handling this same material.

### **Diplolepis tuberculatrix variety rubriderma, new variety**

FEMALE.—Is distinguished from the other varieties of the species as follows: General color bright rufous without much black; head rufous with black between the compound eyes and the mouth, and with black extending posteriorly and medially from the posterior border of each compound eye; first three segments of the antennæ rufous brown, remaining segments black; thorax wholly bright rufous; median groove distinct for only a short distance from the scutellum, but often discontinuously evident well forward; abdomen bright rufous, shaded darker posteriorly; areolet very large, larger than in any other Pacific Coast variety; radial cell more or less open; first abscissa of the radius angulate, sometimes with a very long projection into the radial cell; radial cell and adjacent areas shaded lightly; cubitus apparently continuous; length 3.5-4.5 mm.

MALE.—Very similar to the males of the other varieties; median groove only discontinuously evident except for a short distance at the scutellum; areolet very large, not as large as in the female; first abscissa



of the radius angulate, sometimes with a long projection into the radial cell; length 2.0-2.5 mm.

GALL.—Resembles the galls of other varieties; purplish brown, bearing short spines or filaments, but these are scattered, the gall is not mossy as in *californica*, and upon aging the gall is often left almost smooth.

RANGE.—California: Ukiah. Probably confined to the region of Mendocino and northern Sonoma counties.

TYPES.—100 females, 64 males, 54 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled Ukiah, California; March 17, 1920; Kinsey collector.

Of 289 adults bred only 64, or 22 per cent, are males, probably due to males having emerged mostly before March 17, the date of our collecting.

This variety is not at all closely related to *californica*, though the ranges of these two are proximate, but is very closely related to *sierranensis* and *descansonis* of more southern California. Some further discussion of this peculiar distribution is given with *sierranensis*.

### **Diplolepis tuberculatrix variety sierranensis, new variety**

FEMALE.—Is distinguished from the other varieties of the species as follows: General color bright rufous, with little black; head rufous with a large black patch between the mouth and the compound eyes, sometimes extending to the bases of the antennæ, leaving an intervening rufous strip; first three segments of the antennæ rufous, remaining segments black; thorax wholly rufous; median groove extremely short or absent, never discontinuously indicated anteriorly as in *rubriderma*; anterior parallel lines not prominent; abdomen rufous, shading darker terminally; areolet of moderate size, or usually small to very small; first abscissa of the radius angulate, rather heavier than in *rubriderma*; radial cell more or less distinctly open; cubitus continuous; length 3.5-4.0 mm.

MALE.—Very similar to the males of the other varieties; median groove absent or barely evident at the posterior border of the mesonotum; areolet very small; radial cell open but with a dark marginal shading; first abscissa of the radius angulate; length 2.2-3.2 mm.

GALL.—Almost exactly like that of *rubriderma*.

RANGE.—California: San Jacinto Mountains. Occurs probably throughout the southern Sierran zone of California, from El Portal to the Sierra Madre and the San Jacinto Mountains, except in the San Bernardino Mountains.

TYPES.—45 females, 48 males, 50 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; para-

type adults and galls at Stanford University, the U.S. National Museum, the Museum of Comparative Zoology, the Philadelphia Academy, and with the author. Labelled San Jacinto Mountains, California; February 28, 1920; Kinsey collector.

Of the 93 adults bred, 48, or about 52 per cent, are males.

Tho we have material from only a single locality, our experience with the distribution of other Cynipidæ would suggest the range described above. This range lies between the ranges of *rubriderma* and *descansonis*, to which variety *sierranensis* is very closely related. The galls of all three are very similar, quite distinct from those of any other variety, altho suggesting *californica* galls; in morphologic characters the adults are intermediate between *rubriderma* and *descansonis*. This is another instance of the remarkable phenomenon of a steadily increasing development of characters along a particular geographic course. But the range of this series of varieties crosses the range of the *californica-versicolor-melanderi* series. To have this occur without consequent crossing of varieties, or mergence of one series into the other, is a matter deserving considerable attention. Differences in geologic histories of the two ranges, geographic and genetic origins of the two series, means of preserving the distinctness of each series, are factors to be investigated.

### **Diplolepis tuberculatrix** variety **descansonis**, new variety

**FEMALE.**—Is distinguished from other varieties of the species as follows: General color bright rufous with little black; head rufous brown with a very large black patch between the mouth and the compound eyes and extending to the bases of the antennæ, sometimes with two black marks behind the eyes converging toward the pronotum; first three segments of the antennæ rufous brown, the remaining segments black; thorax rufous brown; median groove entirely absent or just barely evident at the posterior border of the mesonotum; anterior parallel lines not prominent; mesopleuræ almost wholly rufous; scutellum wholly rufous; abdomen rufous, rufous to dark brown posteriorly; areolet usually entirely absent; first abscissa of the radius arcuate-angulate, without a projection; radial cell at least in part open; length 2.0-4.0 mm., averaging smaller.

**MALE.**—Very similar to the males of other varieties; median groove absent or barely evident at the posterior border of the mesonotum; areolet generally absent; first abscissa of the radius arcuate-angulate; radial cell more or less closed; length 2.5-3.5 mm.

**GALL.**—Quite identical with those of varieties *rubriderma* and *sierranensis*.

RANGE.—California: Descanso. Probably confined to the Cuyamaca Mountains and their extensions into Lower California.

TYPES.—18 females, 32 males, 51 galls. Holotype female, paratype adults, and galls at The American Museum of Natural History; paratype adults and galls at Stanford University, the U.S. National Museum, and with the author. Labelled Descanso, California; February 23, 1920; Kinsey collector.

Of the 50 adults, 64 per cent are males. Some of the adults had emerged before collection on February 23, 1920, but the galls still contained larvæ which matured later. This variety is an extreme development of the *rubriderma-sierranensis* series, extreme for instance in the reduction of the median groove and of the areolet.

### Abnormal Galls of *Diplolepis tuberculatrix*

*Rhodites neglecta* Gillette, 1894 (gall), Can. Ent., XXVI, p. 158.

*Rhodites neglectus* Beutenmuller, 1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 639, pl. XLIV, figs. 7, 8. Thompson, 1915, Amer. Ins. Galls, pp. 22, 45. Felt, 1918, N.Y. Museum Bull., 200, p. 146, fig. 152 (7, 8). Kinsey, 1920, Bull. Amer. Mus. Nat. Hist., XLII, p. 391.

*Lytorhodites neglectus* Kieffer, 1902, Bull. Soc. Metz, (2), X, p. 97. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip., p. 79; 1910, Das Tierreich, XXIV, pp. 722, 840.

GALL.—Smooth, rounded stem enlargement. Polythalamous. Varying in size, usually smaller than the variety of *tuberculatrix* involved; the surface very smooth, only occasionally bearing some thorns and lines as of an unopened bud, light straw yellow in color, spotted darker or with black, becoming silvery gray upon aging. Internally rather more corky than in normal galls of *tuberculatrix*, a dense cluster of many larval cells arranged rather radiantly about the center, each cell small, averaging 2.0 mm. or less in length, fifty or more cells often in a cluster. The abnormal galls vary somewhat among the varieties of *tuberculatrix*, but are more uniform even than the normal galls of the species. On roses of the several species.

Gillette said of this gall: "I have long known what I suppose to be the same gall in Michigan and Iowa, but never before succeeded in getting the gall-makers from them." He described two females and one male, supposedly bred from a single gall taken at Manitou, Colorado. Beutenmuller recorded the gall from Fort Collins, Colorado, and Pullman, Oregon. I have the gall from practically every one of the localities in which I collected normal galls of any variety of *tuberculatrix*, ranging thru California, Oregon, Utah, and Colorado. Often both types of galls grow close together on

the same bush. In some specimens of variety *wasatchensis* from Brigham, Utah, half of a gall is typical *neglecta*, the other half of the gall is normal *tuberculatrix* from which normal gall makers emerged. Abnormal galls of variety *californica*, from Salinas, California, do not show so very much difference from the normal galls. Gillette's description of the adult he called *neglecta* would very well apply to a dark form of variety *tuberculatrix*, tho the question of the synonymy of the insect cannot be adequately decided until we can see the types of *neglecta*. These we have not been able to obtain.

Meanwhile we feel quite certain that *neglecta* galls are only inquiline-inhabited galls of *tuberculatrix*. Even if the Gillette adults do not bear out this conclusion we should maintain it until someone has bred material sustaining Gillette's data. The association of insects with the wrong galls is liable to occur with our most precautions methods, and that it has occurred abundantly with many published species is being shown repeatedly. When the number of insects thus connected is small, the chances of confusion become relatively greater. We have three gall makers bred apparently from *neglecta* galls from La Grande, Oregon. Two of them are *Diplolepis oregonensis*, which has a small bud gall easily liable to have been bagged with the *neglecta* material. The other adult is of a variety of *Diplolepis bicolor*, which has a distinct enough gall, but which in some fashion got into my *neglecta* bag in spite of considerable precaution.

The fact that *neglecta* is one of the commonest of galls, easily obtained by the hundreds, breeding out hundreds or thousands of inquiline Cynipidæ without gall makers among them, should have appeared significant. How a gall maker, as rare as this was supposed to be, could produce galls in abundance would be hard to explain. I have definite reasons for questioning the nature of the producer in several other cases of a supposedly rare gall maker, as with the huckleberry gall, *Solenozopheria vaccinii* Ashmead, and another rose gall, *Rhodites globuloides* Beutenmuller.

Inquiline-inhabited galls of many other species of Cynipidæ have their structure considerably modified. *Diplolepis bicolor* (Harris), the related *D. eglanteriae* (Hartig), and the species discussed in the next paragraph are examples in the same genus. We do not know exactly in what



way inquilines replace the true gall maker and modify the normal structure, but are instituting further studies.

*Rhodites globuloides* Beutmuller is an inquiline-inhabited gall very similar to the gall of *neglecta*, but occurring in the eastern part of the United States. In 1892 Beutenmuller described (Bull. Amer. Mus. Nat. Hist., IV, p. 247, pl. IX, fig. 4) an insect from this gall as *Rhodites globulus*. In 1907 he made a correction (Bull. Amer. Mus. Nat. Hist., XXIII, p. 638, pl. XLIV, figs. 2-6) as follows: "The insect described by me as *Rhodites globulus* is a guest-fly, synonymous with *Periclistis pirata* O. S., consequently a new name must be used for the true gall maker. I propose for it *Rhodites globuloides*. \* \* \* The gall of *Rhodites globuloides* occurs on the branches of *Rosa carolina* and is quite common locally in certain localities. I have collected over a hundred specimens of the galls from which I reared hundreds of its guest-fly *Periclistis pirata*, but only a single specimen of the true gall maker."

All of our previous remarks concerning the improbability of a very common gall having such a rare producer apply with even additional force in this case. We have bred many hundreds of the galls, and so have other workers, obtaining thousands of inquilines but not a single gall maker. The holotype female, the only specimen which Beutenmuller had of a gall maker, is in the American Museum. Our notes made three years ago record the date on this holotype as April 25, 1882, which is ten years before the gall was described with an inquiline as the supposed producer, and twenty five years before this true gall maker was described as coming from these galls. This destroys any grounds for the connection of the single specimen with any particular gall.

Until we can find an opportunity to examine this insect further, we cannot give a synonymy with any certainty. Meanwhile it is to be observed that the original description agrees entirely with females of *Diplolepis ignota* (Osten Sacken). We have no data as yet to show what species of rose gall becomes *globuloides* when inhabited by inquilines.

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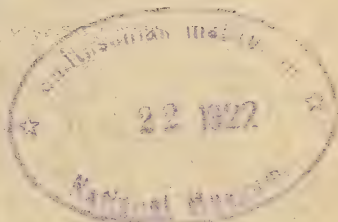








# INDIANA UNIVERSITY STUDIES



Study No. 54

THE ETTRICK SHEPHERD: A BIOGRAPHY

By HENRY THEW STEPHENSON, Professor of English in  
Indiana University



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## Preface

---

THE present writer has been asked the question whether the biography of the Ettrick Shepherd is worth the writing. The answer, of course, is evident: yes, if it is worth the reading. But whether a new biography is needed is another question. The Ettrick Shepherd is a name that has dropped out of popular knowledge in just about the same proportion as has the name of the *Noctes Ambrosianae*. Sixty years ago everyone was familiar with the poetry and prose of Hogg, and there are signs of a renewal of interest in his work. Even today his songs are sung in the Ettrick Forest with unabated pleasure, and the folk are familiar with his tales.

There is at the present time no satisfactory sketch of Hogg's life in print. The interesting *Memoir* by Mrs. Garden makes no pretense to be other than a daughter's loving tribute to her father. The biography in "The Famous Scots Series" is in parts not wholly accurate. The more notable life by Thomson, prefixed to Blackie's edition of Hogg's poems, now long out of print, is, like the others, inaccurate thru having accepted as fact a composition that is largely fiction.

Hogg wrote an autobiography that is true to fact in the main but which contains innumerable errors due to a playful but wilful exaggeration, and to lapses of memory. So far as the present writer knows, no biographer has taken the trouble to investigate the facts contained in the *Autobiography*, much less to note the unsigned and original draft, that differed so much in detail, and that appeared in the *Old Scots' Magazine*. It has been the present writer's pleasant task to search out many details that put the story of Hogg's life, in parts, in a new light.

In perusing these three biographies of Hogg the reader is struck with the fact that none of them deals with him as a literary artist. The fact that he wrote, and what he wrote, seems to be important, but the quality and character of what he wrote is quite neglected. In the following pages some notice of this aspect of his life is taken.

A word of justification may be necessary concerning several extracts of length from *The Spy* and the *Lay Sermons*. There



are accessible now several editions of Hogg's works, prose and verse; but in none of them is any notice taken of his compositions in the nature of the essay. *The Spy* and the *Sermons* are not to be obtained. The extracts are inserted mainly to serve as illustrations of Hogg's style of writing other than verse or prose fiction.

HENRY THEW STEPHENSON.

Indiana University, March, 1922.

## Chronological Note

---

- 1770.....born November(?) 25.  
1770-1776..resided at Ettrickhall.  
1776-1785..served under various masters in the neighborhood, the last of whom was Mr. Scott, of Singlee.  
1785-1787..occupied the position of man-of-all-work on the farm of Mr. Laidlaw, at Elibank.  
1788-1790..obtained full qualification of shepherd under Mr. Laidlaw, of Willanslee.  
1790-1800..shepherd under Mr. Laidlaw, of Blackhouse, on the Douglas Burn in the valley of Yarrow.  
1793.....first trip to the Highlands.  
1794.....*The Mistakes of a Night*, his first publication.  
1797.....first heard of Burns.  
1800-1804..resided at Ettrickhall.  
1801.....publication of *The Pastorals*.  
1804-1807..resided at Mitchel-Slack as shepherd.  
1807.....publication of *The Mountain Bard* and *The Shepherd's Guide*.  
1807-1810..residence in Dumfriesshire.  
1810-1815..residence in Edinburgh.  
1810.....publication of *The Forest Minstrel*.  
1810-1811..editor of *The Spy*.  
1813.....publication of *The Queen's Wake*.  
1815-1822..residence at Altrive Lake.  
1815.....publication of *The Pilgrims of the Sun*.  
1816.....publication of *Mador of the Moor*.  
1816.....publication of *The Poetic Mirror*.  
1817.....publication of *Dramatic Tales*.  
1818.....publication of *The Brownie of Bodsbeck* and other tales.  
1818.....publication of *The Long Pack*.  
1819-1821..publication of *The Jacobite Relics*.  
1820.....marriage.  
1820.....publication of *The Winter Evening Tales*.  
1822-1829..residence at Mt. Bengier.  
1822.....publication of *The Siege of Roxburg, Poems*, in four volumes, and *The Royal Jubilee*.  
1823.....publication of *The Three Perils of Woman*.  
1824.....publication of *The Confessions of a Fanatic*.  
1825.....publication of *Queen Hynde*.  
1829.....publication of *The Shepherd's Calendar*.  
1829-1835..residence at Altrive.  
1831.....publication of *Songs*.

- 1832.....publication of *Altrive Tales*, Vol. 1, *A Queer Book*, and *The Domestic Life of Scott*.  
1834.....publication of *Lay Sermons*.  
1835.....publication of *Tales of the Wars of Montrose*.  
1835.....died November 21.

# The Ettrick Shepherd: A Biography

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## CHAPTER 1

### YOUTH OF THE ETTRICK SHEPHERD

PERHAPS no man's character has ever been so much the offspring of environment and heredity as that of the Ettrick Shepherd. The bald, green hills of Ettrick; Lone St. Mary's Loch with its hillside church so closely linked to the history of Sir William Wallace; the Yarrow—source of poetic inspiration for centuries; the lonely life of a shepherd on the Border hills in the bleak winter when he takes his life in his hands on behalf of his flock, or during the soft summer when he is alone upon the braes with nature for days and weeks at a time—all this tells half the story of the Shepherd's genius. And heredity tells the rest, for of education he had none.

Of his father, Robert Hogg, little need be said. In later life the poet loved to trace his family to some bold North Sea rover by the name of Haug. Suffice it to say here that all such connection is wholly fancy-born.<sup>1</sup> The Hoggs for generations had been shepherds in the Ettrick Valley. Robert Hogg had so far risen above his forbears as to become a tenant farmer on a small scale, a social rank, however, which he was unable to maintain; and while the poet was but a tiny lad the farmer returned once more to his former occupation. Robert Hogg was a plain, honest, sober shepherd, and his tale is told.

It was from the maternal side that James Hogg received whatever of his character is due to heredity. In the secluded churchyard of Ettrick Kirk the grave of his mother's father is marked by the following inscription:

Here lyeth William Laidlaw, the far-famed Will o' Phaup, who for feats of Frolic, Agility and Strength Had no Equal in his day; He was born at Craik A.D. 1691, And died in the 84th year of his age.

<sup>1</sup> In shepherd's parlance a hog is a young sheep that has not yet been shorn.



Laidlaw is an old name in that country, and the William of the above inscription a man of such local note that the following quotations might find place here even if they were not inserted because they body forth so truly the boisterous, athletic shepherd who used to distinguish himself at the St. Ronan's games, and the poet who eclipsed even Sir Walter Scott as one who portrayed the supernatural lore pertaining to the country of his birth.

Will o' Phaup, one of the genuine Laidlaws of Craik, was born in that place in 1691. He was shepherd in Phaup for fifty-five years. For feats of frolic, strength, and agility he had no equal in his day. In the hall of the laird, at the farmer's ingle, and in the shepherd's cot, Will was alike a welcome guest; and in whatever company he was, he kept the whole in one roar of merriment. In Will's days, brandy was the common drink in this country; as for whisky, it was, like silver in the days of Solomon, nothing accounted of. Good black French brandy was the constant beverage; and a heavy neighbor Will was on it. Many a hard bouse he had about Moffat, and many a race he ran, generally for wagers of so many pints of brandy; and in all his life he never was beaten.<sup>2</sup>

Hogg himself wrote so much about the fairies, and wrote so earnestly that, tho he sometimes doubts, he is more often sincere, and we cannot fail to attribute to him far more than the average belief in the folklore of the supernatural. He relates many anecdotes of his grandfather, but considers him most noteworthy because he was the last inhabitant of the Ettrick Valley who held personal intercourse with the fairy folk. He thus describes the incident:

When Will had become a right old man, and was sitting on a little green hillock at the end of his house one evening, resting himself, there came three little boys up to him, all exactly like one another, when the following short dialogue ensued between Will and them:—

"Goode'en t'ye, Will Laidlaw."

"Goode'en t'ye, creatures. Whare ir ye gaun this gate?"

"Can ye gie us up-putting for the night?"

"I think three siccan bits of shreds o' hurchins winna be ill to put up. Where came ye frae?"

"Frae a place that ye dinna ken. But we are come on a commission to you."

"Come away in, then, and tak sic cheer as we hae."

Will rose and led the way into the house, and the little boys followed; and as he went he said carelessly without looking back, "What's your commission to me, bairns?" He thought they might be the sons of some gentleman, who was a guest of his master.

<sup>2</sup> *The Shepherd's Calendar*, Chapter XVIII, Odd Characters.

"We are sent to demand a silver key that is in your possession."

Will was astounded; and standing still to consider of some old transaction, he said, without lifting his eyes from the ground—"A silver key? In God's name, where came ye from?"

There was no answer, on which Will wheeled round, and round, and round; but the tiny beings were all gone and he never saw them more. At the name of God, they vanished in the twinkling of an eye. It is curious that I should never have heard the secret of the silver key, or indeed, whether there was such a thing or not.<sup>3</sup>

Except for his lack of literary genius, Will o' Phaup might sit as model for his grandson's portrait. Let us glance at William's daughter, the mother of the poet.

Margaret Laidlaw, like her son, was a self-taught genius. She lost her mother when she herself was but a child, who, because she was the eldest, was retained at home to take her mother's place and to superintend the household affairs for her father. She saw her younger brothers and sisters growing up under her care, able to enjoy the advantages of school for which she had no time. When but twelve or thirteen years of age, she began to feel the humiliation of their superior knowledge. On Sunday, her only time for rest, she would wander upon the hillsides, alone and dejected. Here, with the Bible under her arm, and, "humbled by a sense of her ignorance she used to throw herself down on the heath and water the page with her bitter tears".<sup>4</sup>

Her afternoons on the hillside, however, were not all spent in tears. From the Bible she taught herself to read, and from it she acquired a love of verse that, as we shall see, led her to encourage her son to memorize the metrical version of the Psalms. She soon became enamored with verse of a very different kind, namely, the ballad-lore of Selkirkshire. From an old wandering minstrel, the last of his race, she learned, it is said, no less than ten thousand lines. She dictated to Scott the ballad of *Auld Maitland* which thus found its way into print for the first time in the pages of the *Minstrelsy*.

She knew also the tales in prose, many of which are to be read in the pages written by her son. She hushed her children to sleep with song and fable, and her native humor made the cottage of Robert Hogg the meeting-place of a famous coterie of shepherds who assembled to hear her tales and

<sup>3</sup> *The Shepherd's Calendar*, Chapter XVIII, Odd Characters.

<sup>4</sup> From an article by Y, "The Life and Writings of James Hogg", in the *Old Scots' Magazine*, January, 1818, page 37.

songs—a coterie famous because doubtless these early scenes gave rise to that inborn taste which at a later date led the Ettrick Shepherd to reproduce the same scenes at his own cottage of Altrive Lake on Yarrow banks, where the places of shepherd swains were taken by such men as “Shirra” Scott, “Willie” Laidlaw, Dominie Russell, and “Christopher North”. Says Mrs. Garden:

Robert Hogg, the poet’s father, was not a man in any way remarkable. A hard-working shepherd, a well-meaning, well-living man, he had saved a little money, and having married, he came to entertain the wish, and to indulge the very natural ambition of becoming a farmer himself. He accordingly took a lease of the farms of Ettrickhouse and Ettrickhall, residing at the time of our poet’s birth at the humble homestead of Ettrickhall. Prosperous for a time, success did not seem to follow his footsteps, and Robert Hogg was compelled to relinquish his farms, and to resume the calling of a shepherd. Mr. Bryden of Crosslea took the farm of Ettrickhouse, and until his own death provided Robert Hogg employment as a shepherd, and his family with a home.<sup>5</sup>

The poet, the second of four sons, was born at Ettrickhall, probably in November or December, 1770. From the hour of his birth, Hogg seems inseparately linked with the fairy folk of whom he sang. His personal friend, Allan Cunningham, thus relates the anecdote:

He was born on the 25th of January, 1772, thirteen years after the birth of Burns; nor was his appearance on the birthday of the poet the only circumstance that marked that something remarkable was given to the world. A midwife was wanted and a timid rider was sent for her, who was afraid to cross the flooded Ettrick; his hesitation was perceived by an elfin spirit—the kindly Brownie of Bodsbeck, who unhorsed the tardy rustic, carried home the midwife with the rapidity of a rocket, and gave a wild shout when the new born poet was shown to the anxious parents.<sup>6</sup>

<sup>5</sup> Page 10.

<sup>6</sup> *Biographical and Critical History of the British Literature of the last Fifty Years*, by Allan Cunningham, 1834.

It will be noticed that this account was published before the death of Hogg, who contradicted neither the facts nor the circumstance narrated in connection with his birth, nor the date, which is incorrect. Hogg was an enthusiastic admirer of Burns, and it was his lifelong wish to emulate his literary hero. Hogg repeatedly asserts that he was born on the above date, and some writers have suggested that he purposely altered the date of his birth to coincide with the anniversary of the birth of Burns. This explanation would not account for the change in year, and any one who is familiar with the Shepherd’s character finds it difficult to entertain such a supposition. It is a fact that Hogg was unusually careless about dates. In two family Bibles he recorded the birth of one of his children as occurring in different months. (Mrs. Garden, page 4.) In different editions of his *Autobiography* he mentions inconsistent dates. In another place he mentions something as having occurred in 1801, and immediately afterward

For six years the family led a comfortable life at Ettrick-hall. His brother William writes the following interesting account of these early days:

He was remarkably fond of hearing stories, and our mother to keep us boys quiet would often tell us tales of kings, giants, knights, fairies, kelpies, brownies, etc., etc. These stories fixed both our eyes and attention, and our mother got forward with her housewifery affairs in a more regular way. She also often repeated to us the metre psalms, and accustomed us to repeat them after her; and I think it was the 122d which Jamie (for I love the words and names used among us at that day) could have said. I think this was before he knew any of the letters. I am certain before he could spell a word. After he could read with fluency, the historical part of the Bible was his chief delight, and no person whom I have been acquainted with knew it so well. If one entered into conversation on that subject, he could with ease have repeated the names of the several Kings of Israel and Judah in succession, with the names of their kingdoms.<sup>7</sup>

The parish school was close adjoining the cottage at Ettrick-hall and little Jamie was soon introduced as a pupil. As was usual, the Shorter Catechism and the Book of Proverbs were used as textbooks, and James made progress for the short space of two or three months. Then came the crash in the family fortunes.

Hogg writes of his father at the time he took a lease of Ettrickhall:

He then commenced dealing in sheep—bought up great numbers and drove them to the English and Scottish markets; but at length, owing to a great fall in the price of sheep, and the absconding of his principal debtor, he was ruined, became bankrupt, everything was sold by auction, and my parents were turned out of doors without a farthing in the world. I was then in the sixth year of my age, and remember well the distressed and destitute condition that we were in. At length the late worthy Mr. Brydon, of Crosslea, took compassion upon us; and, taking a short lease of the farm of Ettrickhouse, placed my father there as his shepherd, and thus afforded him the means of supporting us for a time.

says that he had already seen Scott's *Minstrelsy* (published in 1802-3). Doubtless Hogg recollected the date of his birth wrong, and never felt impelled to discover the truth.

The parish register records his baptism, December 9, 1770. Ettrickhall was hardly a stone's throw from the church, and there is no reason to believe that the ceremony of baptism was deferred beyond the necessary time. Mrs. Garden guesses November 25 as the day of her father's birth.

It may be noted here that there is an obscurity about a few other dates of his early childhood. In his *Autobiography* he refers to several incidents of which there is no other record as having occurred in such and such a year of his life. Should we reckon from the end of 1770 or from the beginning of 1772? The doubt is nowhere of consequence, and in the following pages no further notice will be taken of the fact.

<sup>7</sup> Quoted by Mrs. Garden, page 13.



This gentleman continued to interest himself in our welfare till the day of his untimely death, when we lost the best friend that we had in the world.<sup>8</sup>

Hogg was immediately set to work. His employment was that of herding a few cows, and his principal duty was to keep them out of the unfenced fields. His wages for the half-year was a lamb and a pair of shoes. He writes:

Even at that early age my fancy seems to have been a hard neighbor for both judgment and memory. I was wont to strip off my clothes, and run races against time, or rather against myself; and, in the course of these exploits, which I accomplished much to my own admiration, I first lost my plaid, then my bonnet, then my hat, and, finally, my hosen, for, as for shoes, I had none. In that naked state did I herd for several days, till a shepherd and maidservant were sent to the hills to look for them and found them all.<sup>9</sup>

He continued at this employment for half a year when he was returned to school. He now progressed sufficiently in his studies to read the Bible; but hard times compelled him to resume work again at the end of three months. The present

<sup>8</sup> Hogg never forgot the kindness of Mr. Brydon, whose memory he commemorated in *A Dialogue in a Country Churchyard*, which appeared in the *Scottish Pastorals*, Hogg's first published volume. The last word is italicized because many biographers have overlooked the fact that it was not the first of his publications. During several years, even some time before 1800, which the *Autobiography* mentions as the year in which Hogg's first song was published, Hogg had been writing at intervals for the *Scots' Magazine* under the nom de plume of The Ettrick Shepherd.

<sup>9</sup> From the *Autobiography*. Inasmuch as this memoir will be freely quoted in the following pages it is worth while to define its character at the outset. In the preliminary note the writer says: "I like to write about myself. . . . I must again apprise you, that, whenever I have occasions to speak of myself and my performances, I find it impossible to divest myself of an inherent vanity; but, making allowances for that, I will lay before you the outlines of my life—with the circumstances that gave rise to my juvenile pieces, and my own opinion of them as faithfully

As if you were the minister of heaven  
Sent down to search the secret sins of men."

Hogg certainly possessed a very inherent sense of vanity, as well as the gift of exaggeration, and the fault of inaccuracy. Yet there is no reason to believe that he did not try to carry out sincerely the intention couched in the above words. The substance of the early part of the memoir first appeared in the form of three letters to different numbers of the *Scots' Magazine*. It first appeared in connected form as a preface to *The Mountain Bard* in 1807. It was prefixed to several subsequent publications, in each case continued to date. The last appearance during Hogg's lifetime was in 1832 as preface to the twelve-volume edition of the *Altrive Tales*, only one volume of which was ever published. There are contradictions, omissions, and additions encountered in the different editions, and the version that has appeared since his death has had several personal passages "edited" out.

In spite of such details which render the *Autobiography* questionable evidence upon certain subjects, there is sufficient collateral evidence to enable one to use its pages with sufficient satisfaction. In the present volume the writer has introduced references to the *Autobiography* only when satisfied of their authenticity.

biographer, tho an enthusiastic admirer of the Ettrick Shepherd, does not wish to stultify him unduly by placing him upon a pedestal where he cannot sit with grace. But any reader who has softened to that beautiful lyric which begins

Bird of the wilderness  
Blithesome and cumberless  
Sweet be thy matin o'er moorland and lea,

or who has wept over the pathetic character of Cherry in *The Three Perils of Woman* should not forget that the writer's whole education was comprised within six months spent at school while but yet a lad of six or seven, or that he taught himself to write at the age of twenty by copying letters from the pages of a printed book.

Hogg's earliest ambition was the humble one of writing verses good enough for the maids to sing at the milking; and he always had a tender spot in his heart for the lasses. He writes the following naïve description of his first introduction to the grand passion:

But that summer, when only eight years of age, I was sent out to a height called Broad-heads with a rosy-cheeked maiden to herd a flock of new-weaned lambs, and I had my mischievous cows to herd besides. But, as she had no dog and I had an excellent one, I was ordered to keep close to her. Never was a master's order better obeyed. Day after day I herded the cows and the lambs both, and Betty had nothing to do but to sit and sew. Then we dined together every day at a well near to the Shiel-sike head, and after dinner I laid my head down on her lap, covered her bare feet with my plaid and pretended to fall sound asleep. One day I heard her say to herself, "Poor laddie, he's just tired to death", and then I wept till I was afraid she would feel the warm tears trickling on her knee. I wished my master, who was a handsome young man, would fall in love with her and marry her, wondering how he could be so blind and stupid as not to do it. But I thought if I were he, I would know well what to do.<sup>40</sup>

Of the next ten years of his life little need be said. An anecdote told by his brother William shows that James was a delicate child; but he soon outgrew this condition and, like his grandfather, Will o' Phaup, became noted in his manhood for strength and skill in athletic contests. During this period of ten years he served in different capacities under a dozen different masters. He is careful to note that this frequent changing from place to place was not due to a failure to give satisfaction, but to the fact that his increasing age enabled

<sup>40</sup> *Autobiography.*

him to procure a better position and better wages. He never failed to carry a warm recommendation from an old master to a new one.

In 1785 he went to serve a Mr. Scott at Singlee. While here he managed to save five shillings with which he bought a fiddle on which he used to practice at night in the cowhouse. And Mrs. Garden relates how from that time till his death he was never without such an instrument and seldom long without affording himself the pleasure of playing.

From Singlee he went to Elibank on the Tweed below Innerleithan, where he served as a man-of-all-work under Mr. Laidlaw during 1785-7. He then went to Mr. Laidlaw's father at Willanslee, upon whose wild and barren farm he remained till 1790. Here, for the first time in his life, he was employed as a shepherd. The days of his youth were passed, and henceforth he could undertake the responsibilities of a man, and claim a man's remuneration.

One who, to use Hogg's own phrase, "dabbled so much in verse" is likely to show an unusual relish for it at first. Tho true of Hogg in regard to his early liking for the metrical Psalms, it is true no further. He was fortunate in finding at Willanslee a master and mistress who took a kindly interest in his personal welfare. They lent him books and for the first time his literary horizon widened beyond the Bible. But interest in what he read lay wholly on the side of prose.

It was while serving here. . . . that I first got a perusal of the *Life and Adventures of Sir William Wallace*, and the *Gentle Shepherd*. . . . The truth is I made exceedingly slow progress in reading them. The little reading I had learned I had nearly lost, and the Scottish dialect quite confounded me; so that, before I got to the end of a line I had commonly lost the rhyme of the preceeding one; and if I came to a triplet, a thing of which I had no conception, I commonly read to the foot of the page without perceiving that I had lost the rhyme altogether. . . . The late Mrs. Laidlaw of Willanslee took some notice of me, and frequently gave me her books to read while tending the ewes; these were chiefly theological. The only one I remember anything of is Bishop Burnet's *Theory of the Conflagration of the Earth*. Happy it was for me that I did not understand it! for the little of it that I did understand had nearly overturned my brain altogether. . . . Mrs. Laidlaw also sometimes gave me the newspapers which I pored on with great earnestness, beginning at the date and reading straight on, through advertisements of houses and lands, balm of Gilead, and everything; and, after all, was often no wiser than when I began. . . . I was about this time obliged to write a letter to my elder

brother, and, never having drawn a pen for such a number of years, I had actually forgotten how to make sundry letters of the alphabet; these I had either to print, or to patch up the words as best I could.<sup>11</sup>

At Whitsuntide 1790 Hogg left Willanslee and took service under another Laidlaw at Blackhouse on the Douglas Burn, a petty tributary of the Yarrow. For ten years he remained as a shepherd at Blackhouse. It was there that his character was moulded into its final form; it was while there that he first heard of Burns, a fact that gave rise to his life ambition; it was while there that he conquered the mechanical difficulty of writing and began to compose rhymes; and from Blackhouse he sent forth the first songs that appeared in print, winning for the "Ettrick Shepherd" a small measure of local fame.

When he went to Blackhouse in 1790 he was a strong young fellow just on the threshold of manhood, a shepherd with a recommendation but as yet young in experience, ignorant, able to read but slowly and with difficulty, and unable to write at all. As yet he had given no evidence whatever of literary feeling or genius. However, within ten years he had learned to read fluently, to compose with a fair degree of rapidity, and to write on paper with tolerable ease. In addition to this, 1800, the year in which he left Blackhouse, found him the author of *Donald McDonald*, a spirited war song that was ringing over the whole of England and Scotland.

For ten years, beginning with 1790, Hogg herded sheep in the most romantic part of the Border country. This decade is the most significant in his life, not because it marks the beginning of his literary career, for nothing he wrote previous to 1800 is worthy of attention, but because during this period he met the friends who henceforth guided his life, and because the sojourn at Blackhouse converted his character from youthful formlessness to what it afterward became.

The Ettrick and Yarrow valleys trend northeast in nearly parallel lines for a score of miles till they unite in the historic neighborhood of the battlefield of Philiphaugh close to Selkirk. On the Ettrick road, an hour's walk from the latter town still stands the ancient peeltower of Oakwood, the reputed abode of the wizard Michael Scott. As one passes up the winding valley one sees the places that figure in the ballads

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<sup>11</sup> *Autobiography*.



*Young Tamlane and Jamie Telfer of the Fair Dodhead.* Kirkhope tower is in sight; and the ruined vault of Tushielaw, where lived Adam Scott, the most famous of the Border raiders, still perches high upon its commanding hill. On one side climbs the road traversed by King James that time he found a grave for Percy Cockburne, when his wife's agony gave its present name to one of the most romantic dells of beauty in the Border. On another side diverges a road towards the famous tower of Branksome; while straight ahead goes the road to Ettrick Kirk where Thomas Boston taught the gospel and wrote the *Fourfold State*.

History, poetry, and legend have left their stamp at every turn; and our shepherd was born in the very midst of all this, used from his cradle days to the outpouring of neighborhood lore by the fireside of his mother's cottage. But, tho Hogg is known far and wide thru Scotland as the Ettrick Shepherd, the real associations of his life are with the sister vale of Yarrow whence he returned to Ettrick only to be borne by others to a quiet grave in the shelter of Boston's church.

A little south of Ettrickhall where the poet was born, a bridle path climbs steeply up the mountain side towards Yarrow. After the highest elevation is reached the path runs level for some distance amid wild and desolate hills. There is no sign of human habitation, no sound of companionship save the occasional bleat of a sheep upon the brae side. Once the lonely traveler can catch a distant glimpse of the King's Road and is likely to wonder how often the poet-shepherd tramped this path and thought of the Scottish king and his swift descent upon the robber king of Tushielaw. Then the path begins to wind and drop between stacks of peat till at last a broad view opens with the swiftness of a breaking storm. The ravine on the left is where the martyr Renwick preached his last sermon among the hills. The white farmhouse far below is the scene of Hogg's most widely read novel, *The Brownie of Bodsbeck*. Every spot within sight bears to this day wild tales of Covenanter heroism and Claverhouse's cruelty. The sheet of water to the right is the Loch of the Lowes and the white mark beyond it on the hillside, a gigantic stone figure of the Shepherd close by Tibbie Shiel's.

So far, history and legend have not left our footsteps. Poetry soon resumes its sway. Another mile brings us to St.

Mary's Loch. On the hillside is the yard of St. Mary's church, long since disappeared. From there on down the valley, past "Dryhope's ruined Tower", the Dowie Dens of Yarrow, past Newark, back to Selkirk, every milestone marks the scene of one of those grand old ballads such as *The Gay Goshawk* and *The Outlaw Murray*. Save for a few intervals, the Ettrick Shepherd never escaped the influence of such surroundings, an influence that is to be felt in every page he wrote.

But a short distance down the Yarrow from the loch is the junction of the Douglas Burn, a harmless looking rill in the bottom of a pleasant valley. Yet we know from the article on *Storms* how grim and terrible it could become upon occasion. Three miles up the Douglas Burn stand the ruins of Blackhouse tower, once a possession of the Black Douglas, and on the hillside near are the "standing stones" which, tradition asserts, are the scene of the *Douglas Tragedy*. Here, in the neighboring farmhouse, tenanted by the third Mr. Laidlaw for whom Hogg shepherded, the poet came to live. The farm is almost at the head of the valley in its wildest part, and among these barren hills Hogg shepherded for ten years. During a large part of each year he was more or less alone on the hills for days at a time in company with his sheep. How this nature-communion affected his character can best be told in his own words:

It is almost impossible, also, that a shepherd can be other than a religious character, being so much conversant with the Almighty in his works, in all the goings-on of nature, and in his control of the otherwise resistless elements. He feels himself a dependent being, morning and evening, on the great Ruler of the universe; he holds converse with him in the cloud and storm—on the misty mountain and the darksome waste—in the whirling drift and the overwhelming thaw—and even in the voices and sounds that are only heard by the howling cliff or solitary dell. How can such a man fail to be impressed with the presence of an eternal God, of an omniscient eye, and an almighty arm?<sup>12</sup>

Hogg began his service at Whitsuntide in 1790, and no place in the Border could so well have helped to bring out the poetic element in his nature; for, besides the poetic surroundings, he found in Mr. Laidlaw not only a master but also a friend. He possessed a good library among the books, of which were to be found the writings of Milton, Pope, Thompson, Young, and *The Spectator*. Laidlaw encouraged Hogg to read. The

<sup>12</sup> *The Shepherd's Calendar*, Chapter XVII.

latter's strong mind became rapidly burdened with diversified facts and examples of the best literary expression in the language, details which it tenaciously retained. Before long the difficulties in reading which a short time before had caused him to lose track of the lines in rhyme disappeared altogether. His companionable intercourse with Mr. Laidlaw's son William, Sir Walter Scott's amanuensis, his beloved "Willie" Laidlaw, not only sharpened Hogg's intellectual powers and refined his literary taste, but also eventually procured for him the introduction to Sir Walter Scott upon which depended so much of the Shepherd's future success.

Hogg's personal appearance at this time is well described by his brother William:

Four and fifty years ago when Hogg was nineteen years of age, his face was fair, round, and ruddy, with big blue eyes that beamed with humour, gaiety, and glee. And he was not only then, but throughout his chequered life, blessed with strong health, and the most exuberant animal spirits. His height was a little above the average size, his form at that period was of faultless symmetry, which nature had endowed with almost unequalled agility and swiftness of foot. His head was covered with a singular profusion of light brown hair, which he usually wore coiled up under his hat. When he used to enter church on Sunday (of which he was at all times a regular attendant), after lifting his hat he used to raise his right hand to his hair to assist a shake of the head, when his long hair fell over his loins, and every female eye at least was turned upon him as with a light step he ascended to the gallery, where he usually sat.<sup>13</sup>

For several years Hogg led an uneventful life at Blackhouse. In 1793 he made his first trip to the Highlands, journeying thither in charge of a flock of sheep which he delivered at Strathfillan in Perthshire. 1796 is the year in which his *Autobiography* says that his literary career began.<sup>14</sup>

The first time that I attempted to write verses was in the spring of the year 1796. Mr. Laidlaw, having a number of valuable books, which were all open to my perusal, I about this time began to read with considerable attention—and no sooner did I begin to read so as to understand, than, rather prematurely, I began to write. For several years my compositions consisted wholly of songs and ballads made up for the lasses to sing in chorus; and a proud man I was when I first heard the rosy nymphs chaunting my uncouth strains, and jeering me by the still dearer appellation of "Jamie the poeter".

I had no more difficulty in composing songs then than I have at present; and I was equally well pleased with them. But then the writing

<sup>13</sup> Quoted by Mrs. Garden, page 21.

<sup>14</sup> See page 12.



of them!—that was a job! I had no method of learning to write, save by following the Italian alphabet; and though I always stripped myself of coat and vest when I began to pen a song, yet my wrist took a cramp so I could rarely make above four or six lines at a sitting. Whether my manner of writing it out was new, I know not, but it was not without singularity. Having very little spare time from my flock, which was unruly enough, I folded and stitched a few sheets of paper, which I carried in my pocket. I had no inkhorn; but in place of it I borrowed a small phial which I fixed in a hole in the breast of my waistcoat; and having a cork fastened by a piece of twine, it answered the purpose fully as well. Thus equipped, whenever a leisure minute or two offered, and I had nothing else to do, I sat down and wrote out my thoughts as I found them. This is still my invariable practice in writing prose. I cannot make out one sentence by study, without the pen in my hand to catch the ideas as they arise, and I never write two copies of the same thing.<sup>15</sup>

Nothing illustrates so aptly the isolated life led by the Yarrow shepherds as the fact that Hogg never so much as heard of the existence of Burns till 1797, the year after he died.

One day during that summer a half daft man, named John Scott, came to me on the hill, and to amuse me repeated *Tam O'Shanter*. I was delighted! I was far more than delighted—I was ravished! I cannot describe my feelings; but, in short, before Jock Scott left me, I could recite the poem from beginning to end, and it has been my favorite poem ever since. He told me it was made by one Robert Burns, the sweetest poet that ever was born; but that he was now dead, and his place would never be supplied. He told me all about him, how he was born on the 25th of January, bred a ploughman, how many beautiful songs and poems he had composed, and that he had died last harvest, on the 21st of August.

This formed a new epoch of my life. Every day I pondered on the genius and fate of Burns. I wept, and always thought with myself—what was to hinder me from succeeding Burns, I too was born on the 25th of January,<sup>16</sup> and I have much more time to read and compose than any ploughman could have, and can sing more old songs than ever ploughman could in the world. But then I wept again because I could not write. However, I resolved to be a poet, and to follow in the steps of Burns.<sup>17</sup>

Hogg, of course, never equalled Burns as a poet, but, considering the difficulties against which he had to contend, we may well say that he fulfilled his resolution nobly. From this date we hear constantly of his literary efforts, tho for some

<sup>15</sup> *Autobiography*.

<sup>16</sup> See page 10.

<sup>17</sup> *Autobiography*.



time, he goes on to tell us, William Laidlaw was the only person who found the least merit in his verses. But here, as in some other places, Hogg is exaggerating the trials of his early apprenticeship to letters for the sake of effect. He had in reality begun to be locally recognized by this time.

Hogg's first attempt at composition of which anything is known was a poetical epistle to a student friend of divinity, composed of borrowed lines from Dryden's *Virgil* and Harvey's *Life of Bruce*. The first piece wholly his own was *An Address to the Duke of Buccleugh on Behalf o' mysel' and ither poor folk*. Then *The Way that the World goes on* and *Wattie's and Geordie's Foreign Intelligence* earned for him the title of which he was so proud—Jamie the poet.

There was a group of men commonly known as the Big Four, who met generally upon the hillside for self-improvement. This coterie consisted of Hogg and William Laidlaw and their brothers, William Hogg and Alexander Laidlaw. They would prepare essays and write verses, read to one another, criticize and lay wagers upon their respective abilities. A full account of their doings and how their incantations were thought in the countryside to have raised the devil and produced the great storm of 1794 is fully set forth in the paper on *Storms*. The *Autobiography* contains another interesting anecdote about the early work of this set.

In the spring of the year 1798, as Alexander Laidlaw, a neighboring shepherd, my brother William, and myself, were resting on the side of a hill above Ettrick Church, I happened in the course of our conversation to drop some hints of my superior talents in poetry. William said, that, as to putting words into rhyme, it was a thing which he never could do to any sense: but that, if I wished to enter the lists with him in blank verse, he would take me up for any bet that I pleased. Laidlaw declared that he would venture likewise. This being settled, and the judges named, I accepted the challenge; but a dispute arising respecting the subject, we were obliged to resort to the following mode of decision: Ten subjects having been named the lots were cast, and, amongst them all, that which fell to be elucidated by our matchless pens, was, *the stars!*—things which we knew little more about, than merely that they were burning and twinkling over us, and to be seen every night when the clouds were away. I began with high hopes and great warmth, and in a week declared my theme ready for the comparison; Laidlaw announced his next week; but my brother made us wait a full half year; and then, on being urged, presented his unfinished. The arbiters were then dispersed, and the cause was never properly judged; but those to whom they were shown rather gave the preference to my brother's. This is certain that it was far superior to either of

the other two in the sublimity of the ideas; but, besides being in bad measure, it was often bombastical. The title of it was "Urania's Tour"; that of Laidlaw's, "Astronomical Thoughts"; and that of mine, "Reflections on a View of the Nocturnal Heavens".<sup>18</sup>

On page 12, 1796 is given as the beginning of Hogg's literary efforts. This is the date given in the *Autobiography*, but is evidently an error. At the beginning of the first edition of the *Autobiography* in its permanent form Hogg refers to the fact that the material had already appeared in the form of three letters. No biographer has seemed to think it worth while to look up the origin of this interesting piece of writing. These letters appeared in the *Scots' Magazine* in the years 1804-5, and, as the writer says, are concerned far more with trifles than the later edition. In them 1793 is given as the date of *This is the way the World goes on*, of *Willie and Geordie*, and of the address to Buccleugh. Similarly, biographers have followed Hogg's assertion that his first published poem was *Donald MacDonald*, printed in 1800. Hogg's forgetfulness of material of which he was not afterward proud is proverbial. A little search after truth, however, unearths from the pages of the *Scots' Magazine* the *Mistakes of a Night*, published in October, 1794. This poem is unsigned, but is claimed by Hogg in one of the *Autobiographical Letters*, and on page 624 of the magazine for that issue is the following editorial footnote:

We are disposed to give the above a place to encourage a young poet. We hope he will improve, for which end we advise him to be at more pains to make his rhymes answer, and to attend more to grammatical accuracy.

The second autobiographical letter gives us the information that *Glengyle* (1794) was founded on a story told by an old woman named Cameron who had been interested in the rebellion of 1745; and that *The Happy Swains* was another story from the same source and filled 150 pages.

In 1795 he Hogg<sup>19</sup> was summoned to Selkirk as a witness against one of his acquaintances for fishing in close time, and, being persuaded by several of his companions interested in that business, that it was both sinful to swear and base and shameful to betray his acquaintance, he either evaded or refused to give direct answers to the questions put to him for some time; at length, seeing there was no alternative, he re-

<sup>18</sup> *Autobiography*.

<sup>19</sup> *Autobiographical Letters*. They were written in the third person.

luctantly complied, but at the same time told his persecutors that he would soon find a way to expose their ignorance and sacrilegious conduct to the world; and immediately he set about writing his *Scots Gentleman*, a comedy in five acts, one of which was entirely occupied with the examination of the fishers. This piece, though it no doubt has its faults, yet, in general, is not destitute of merit; the last mentioned part in particular is so replete with blunt but natural answers, that it never fails to excite the most lively burst of laughter when read to an Ettrick audience.

The recovery from a serious illness was commemorated in 1798 by *Farewell ye Grots, Farewell ye Glens*. Hogg records this illness in the *Autobiography* but omits the account of the poem contained in the corresponding Autobiographical Letter. And previous to 1799 Hogg had published several pieces in *The Edinburgh Magazine*.

In the year 1800, I began and finished the first two acts of a tragedy, denominated *The Castle in the Wood*; and flattering myself that it was about to be a masterpiece I showed it to Mr. William Laidlaw, my literary confessor; who, on returning it, declared it faulty in the extreme; and perceiving that he had black strokes drawn down through several of my most elaborate speeches, I cursed his stupidity, threw it away, and never added another line.<sup>20</sup>

While it is true that none of this verse belies the editorial note quoted above, and none is worth republishing in a collective edition of the Shepherd's works, an examination of it fully prepares one to find him in 1800 the author of a spirited and finished song that at once caught the popular fancy and went far towards bringing fame to one who had hitherto enjoyed only a local and anonymous reputation on a small scale.

<sup>20</sup> This paragraph appeared in the *Autobiography* of 1807, and 1821, but was omitted from the later editions.

The above fact explains Mrs. Garden's ignorance of the identity of the Scotch Gentleman "whom Hogg murdered" as set forth in his earliest extant letter. See Mrs. Garden's *Memoirs*, page 37.

## CHAPTER 2

### THE PASTORALS AND THE MOUNTAIN BARD

THE immediate cause of Hogg's leaving Blackhouse was the condition of his family at home. His father had grown too old to manage the farm himself. William, the eldest son, was married and found the house too small for the convenience of his family, so James came over from Yarrow to take temporary charge of affairs.

He returned to Ettrick at Whitsuntide, and in this year, 1800, was published what is generally considered as his earliest printed song. The immediate popularity of *Donald MacDonald* was very great, and Hogg gives several amusing anecdotes of times when it was sung in music halls thruout the land as well as at the tables of the military magnates. It, however, added little to his reputation as a poet, for, as Hogg says, it was generally sung without any attention paid to him who wrote it.

Hogg was always vain of his powers, and the reception of this song for a time turned his head. In a few months, in 1801, Hogg went to Edinburgh to sell a flock of sheep. They were not all disposed of at once, a fact that required him to remain over in the capital till the next market day. In order to expend the time profitably he decided to issue a volume of verse. In great haste he set about the task of transcribing some of his earlier poems from memory and transmitted them to a printer in a state the imperfection of which afterward caused him much chagrin. He laments this rash adventure in the *Autobiography*, but the tiny volume forms an important link in the tangible development of his genius.<sup>1</sup>

The volume consisted of 62 pages; and a list of errata mentions 8 mistakes, sufficiently disproving Hogg's later assertion that the volume abounded in errors on every page. T. Craig-Brown in his *History of Selkirkshire* says that

Hogg had the weakness to pretend that he had hurriedly written out the contents from memory during his two days' stay at Edinburgh; but he elsewhere let it out that the manuscript had the advantage of leisurely revision by Laidlaw and Clarkson.

<sup>1</sup> *Scottish Pastorals—Poems, Songs, etc, mostly written in the dialect of the south,—* By James Hogg,—Edinburgh. Printed by John Taylor, Grassmarket, 1801. Price one shilling.



Were it not for the care this author shows in other parts of his work one would be prompted to let this assertion go as quite unfounded, it is so opposed to Hogg's own account of the transactions and to the accounts given by several of his contemporaries who were his personal friends.<sup>2</sup> The remark that Hogg "let out" may be interpreted to mean merely that there was a chance to condemn the proof sheets that was not taken. In all probability Hogg saw no reason to belittle the work till he began subsequently to trim his sails in accordance with the failure recorded by its reception. There can be no doubt that the Shepherd thought well of the poems at the time. He quoted five stanzas of the *Dialogue in a Country Churchyard* in one of his *Letters from the Highlands* (1802) and was much pleased to find *Willie and Keatie* republished in the *Scots' Magazine* (January, 1801, page 52).

And, indeed, Hogg had reason to be proud. When one considers that these poems were written long before 1801, when Hogg was raising himself almost unaided from the condition of an ignorant shepherd, one finds them marvelous enough. But few, perhaps none, of the readers of the little volume, at the time of its appearance, knew much about the name on the title page. Judged without allowance for the conditions under which these poems were written, the verses seem poor enough to deserve the oblivion into which they promptly fell. Much of what is good in the volume is contained in the second song, which is not even dignified with a title. What is elsewhere mere jingle here passes into true rhythm:

O Shepherd, the weather is misty and changing,  
Will you show me over the hills to Traquair?

She's young and she's witty, she's lovely and pretty,  
She's chaste as the swans upon Lochfell at Yule.

In *Dustie* we find one of those sympathetic passages about dogs that abound in the Shepherd's writings:

But yet for a' his gruesome dealins',  
He was a dog o' tender feelins';  
When I lay sick and like to die,  
He watched me wi' a constant eye;  
An' then when e'er I spak' or stirred,  
He wagged his tail, an' whinged an' nurr'd.  
When saams were sung at any meetin',  
He yowl'd an' thought the fock war greetin'.

<sup>2</sup> See *Memoirs of a Literary Veteran*, by R. P. Gillies, Vol. 1, page 120; also Mrs. Garden, page 33, where she quotes the *Autobiography* without contradiction.

*Willie and Keatie*, on the whole, is far the best of the volume. It tells a simple love tale with genuine feeling in the simplest language, and displays the author's love and accurate observation for nature.

From these rugged prospects turn ye;  
Mark yon rauntree spreading wide,  
Where the clear but noisy burnie  
Rushes down the mountain side.

Ten lang days I thought upon her,  
Quite deprived o' peace an' rest;  
Findin' I could brink no langer,  
I resolved to do my best.

Now my yellow hair I plaited,  
Gae my downy chin a shave,  
Thrice my tales of love repeated,  
Fearin' I would misbehave.

Far away I took my journey,  
Left our hills sae high an' green,  
Thro' a pleasant fertile country,  
Which I ne'er before had seen.

Here we're charmed wi' works o' nature,  
Craggy cliff, an' lonely glenn;  
There I oft stood like a statue,  
Wond'ring at the works o' men.

Verdant pastures, grand inclosures,  
Thrivin' woods, an' buildins' new,  
Hale hillsides sawn up wi' clover,  
Ev'ry where arose in view.

Lang I gaed and kendna whither,  
Struck wi' ilka thing I saw,  
Where yon little windin' river  
Murmurs ower the stanes sae sma'.

Phoebus, now in all his glory,  
Sunk into the western main;  
Frae his labour, soft an' slowly,  
Homeward trudged the weary swain.

Nature, freed frae her auld lover  
Roughsome winter, gaunt and lean;  
Spring to charm, whose airs had moved her,  
Rob'd herself in cheerful green.

A' their little feathered tenants  
Sweetly sang on ilka tree;  
Lads an' lasses, wives an' callants,  
A' were gay but lonely me.

Walkin' thro' the elms sae stately,  
Thinkin' on the step I'd ta'en,  
There I met my bonny Keaty,  
Comin' thro' the wood her lane.

Fear'd and fond, when I approach'd her,  
How my heart began to beat!  
But I ventured to accost her,  
Askin' where she gaed sae late?

Wi' a smile that quite bewitch'd me,  
She return'd, "What's that to thee?  
"Ere you reach the town that's next ye,  
"Lad, ye'll be as late as me."

Mony question I spiered at her,  
Mony ane I kend fu' weel,  
If an inn stood on the water,  
Where a stranger wad get biel?

Where she liv'd, an' what they ca'd her,  
Father's name and mother's too,  
Ilka burn an' ilka water,  
Ilka house within our view.

Lang we stood amang the timber,  
Frae me she could never win;  
How the sterns began to glimmer,  
Drowsy twilight clos'd his een.

"Shepherd," said she, "I wad thank ye,  
"Wad ye turn and set me hame;  
"Ghasts an' witches are sae plenty,  
"I'm afraid to gang my lane.

"When we reach my father's dwellin',  
"Ye's hae bed an' supper free;  
"They'll requite ye when I tell them  
"How ye've been sae kind to me."

Happy in the fair occasion,  
How I blest her bonny face,  
Nor received the invitation,  
Proffered me wi' sic a grace.

This unimportant volume has been given more space, perhaps, than it deserves, but none of the poems has been included in subsequent editions and the volume itself is not now to be had.

In the autumn of 1802 occurred the most important single event in Hogg's life—his meeting with Sir Walter Scott. Hogg had already seen a portion of the *Minstrelsy* which dealt with a subject as familiar to him as to Scott. He at once set to work to write some "old ballads" which he forwarded to Scott. Sir Walter, then Mr. Scott, became interested, and in his next "raid" he hunted up the poet-shepherd. In the *Life of Scott*<sup>3</sup> Hogg refers to this as his first meeting with Sir Walter, and many have copied the assertion as a fact. It is, however, but another example of Hogg's forgetfulness. The following letter to Scott is dated June 30, 1802:

Dear Sir,—I have been perusing your *Minstrelsy* very diligently for a while past, and it being the first book I ever perused which was written by a person I had seen and conversed with, the consequence hath been to me a most sensible pleasure; for in fact it is the remarks and modern pieces that I have most delighted in, being as it were personally acquainted with many of the antient pieces formerly.

My mother is actually a living miscellany of old songs. I never believed that she had half so many till I came to a trial. There are none in your collection of which she hath not a part, and I should by this time have had a great number written for your amusement, thinking them all of great antiquity and lost to posterity—had I not luckily lighted upon a collection of songs in two volumes, published by I know not whom in which I recognized about half a score of my mother's best songs almost word for word. No doubt I was piqued but it saved me much trouble, paper, and ink; for I am carefully avoiding everything which I have seen or heard of being in print, although I have no doubt that I shall err, being acquainted with almost no collections of that sort; but I am not afraid that you too will mistake. I am still at a loss with respect to some. . . .

Suspend your curiosity, Mr. Scott. You will see them when I see you. . . . But as I suppose you have no personal acquaintance in this parish, it would be presumption in me to expect that you will visit my cottage, but I will attend you in any part of the Forest if you will send me the word. I am far from suspecting that a person of your discernment—d—n it, I'll blot out that word, 'tis so like flattery—I say I don't think you will despise a shepherd's "humble cot and hamely fare" as Burns hath it; yet though I would be extremely proud of the visit, hang me if I know what I should do w'ye. I am surprised to find that the songs in your collection differ so widely from my mother's. . . .

Many indeed are not aware of the manners of this place; it is but

<sup>3</sup> See page 95.



lately emerged from barbarity, and till this present age the poor illiterate people in these glens knew of no other entertainment in the long winter nights than in repeating and listening to these feats of their ancestors which I believe to be handed down inviolate from father to son for many generations, although, no doubt, had a copy been taken of them at the end of every fifty years, there must have been the same difference which the repeater would have insensibly fallen into, merely by the change of terms in that time. I believe it is thus that many very antient songs have been modernized. . . .

Pardon, my dear Sir, the freedom I have taken in addressing you,—it is my nature and I could not resist the impulse of writing to you any longer. Let me hear from you as soon as this comes to your hand, and tell me when you will be in Ettrick Forest, and suffer me to subscribe myself, your most humble and affectionate servant,

JAMES HOGG.

It was this letter that brought Scott to the Shepherd's hut and resulted, among other things, in the addition of the ballad of *Auld Maitland* to the collection of the *Minstrelsy*. Many merry adventures concerning their antiquarian hunt are related in the *Autobiography* and are also described twenty years later in *Lines to Sir Walter Scott*. This, tho not their first meeting was the beginning of their friendship which lasted till the death of Sir Walter. For thirty years his kindly nature never lost sight of the self-cultivated shepherd whom he assisted first and last in a thousand ways.

About this time, Hogg, who was always looking somewhere else, in a mistaken notion that he could thus better his condition, undertook a journey to Harris. His acquaintance with the Highlands is connected with an interesting page in his literary career. His first trip thither was in 1793 when he took a flock of sheep from Blackhouse to Strathfillan. In 1801 he traveled in the Grampian Mountains and penetrated as far as the sources of the river Dee. A series of five letters that appeared in the *Scots' Magazine* between October, 1802, and June, 1803, are addressed to S——— W——— Esq. A fourth tour was similarly described in a series of letters that were printed by Alexander Gardner of Paisley in 1888, with the following Introductory Note:

The following letters, descriptive of a tour which the Ettrick Shepherd made in the Highlands in the year 1803 have recently been discovered by his daughter, Mrs. Garden, among her father's papers. They were to all appearance intended for the eye of Sir Walter Scott, but whether they were ever read by him is unknown. So far as can be ascertained after the most careful search they have never before been

published. There is no reference to them in Hogg's *Autobiography*, and until recently the survivors of the family were not aware of their existence. The letters speak for themselves, and it is unnecessary here to say more than that they appear to have been written by the Shepherd from memory soon after his return home, and some five years before the publication of *The Lady Of The Lake*.<sup>4</sup>

During the tour of 1803 he visited the outer Hebrides and came home full of the idea of migrating to Harris. During the ten years he had spent at Blackhouse he had managed to save some two hundred pounds, which, in conjunction with the capital of a neighbor, he decided to sink in the adventure. A farm was procured and the necessary stock bought, and all preparations made for the departure. Hogg wrote the *Farewell to Ettrick*, the tenderest of all his pathetic poems, and was ready to tear up the old ties forever. His partner was actually on his way north with the stock when word came in July, 1804 that, thru some legal flaw in the title they could not have possession of the farm. In consequence, both Hogg and his partner lost all they had and the Shepherd found himself a ruined man. This was the first of many ill-advised ventures that resulted in disaster and temporarily reduced him to beggary. But his flow of spirits was unconquerable and he experienced only a momentary depression. He retired for the summer into Cumberland. He doubtless visited Keswick, but on this subject Hogg was always very reticent. On his return to Scotland in the autumn he gave up the notion of farming on his own responsibility and became shepherd to a Mr. Harkness at Mitchel-Slack.

He remained here till 1807, during which time he met his brother poet, Allan Cunningham, and improved his acquaintance with Sir Walter Scott. In 1806 a letter of Scott refers to Hogg's business as a factor in valuing lands, an avocation he followed with slight success as late as 1811. While at Mitchel-Slack his constant companion was Hector, the collier

<sup>4</sup> The writer of this note has evidently overlooked the fact that these letters are referred to in one of the Autobiographical Letters tho not in the *Autobiography* in its later form. "I had meant to give some account of his *Journey through the Highlands*, and *The Mountain Bard*; two publications of Mr. Hogg's nearly ready for the press." (Second letter, written after the publication of the first series of letters and before the trip described in the third had been taken.) "He was afterward employed in preparing for the press his first, second, and third journeys through the Highlands; and in composing several pieces, some of which have been published in the Magazine, and which he intends to publish in a volume by themselves as soon as a few illustrations are got ready." (Third letter.) The third journey referred to in the above was similarly described by letters that appeared in the *Scots' Magazine* from June, 1808, to March, 1809.

whose effigy now adorns the monument at the head of St. Mary's Loch.

The climax of his sojourn at Mitchel-Slack was the publication in 1807 of *The Mountain Bard*. This volume had been under way for some time. As early as 1803 Hogg dined with Scott, a dinner that gave rise to a story told by Lockhart to Hogg's discredit which, however, probably did not happen just as the great biographer tells it. Something unseemly, however, did happen as is proved by Hogg's letter of apology written to Scott the next day, but it was insufficient to offend Sir Walter and needs no further attention here. This dinner had been brought about for the purpose of discussing the publication of *The Mountain Bard*, and it was doubtless due to Scott's advice that the book was held back for several years. At last Constable was persuaded to publish it, and it appeared dedicated to Sir Walter Scott. The *Autobiography* gives a humorous and characteristic account of the dealings with the publisher. He was at first averse to the transaction and informed the Shepherd that poetry would not sell. The writer sturdily defended his own verse on the score that it was as good as anybody's and, when told that no verse would sell, fancied everybody's hand against him. He also narrates the slipshod way in which he delivered the subscription copies, getting nothing for some and ten times their value for others. Simultaneously, Constable published *Hogg on Sheep*, a practical handbook for shepherds, that received a prize from the Highland Society. From these two books Hogg realized about three hundred pounds.

This is as fitting a place as any to consider the *Autobiography* which first appeared as a preface to *The Mountain Bard*. In the issue of August 4, 1804, of the *Scots' Magazine* is a letter signed by J. Welch, which speaks of the contributions of Hogg in the highest terms, and desires some personal information concerning the new poet who bids fair to "rival if not excel all that have yet written in the Scottish dialect". The editor answers that he knows nothing beyond the fact that he believes the author "is actually a shepherd". A few further facts are contained in a letter signed A.H.B. that appeared in the issue for October of the same year. To satisfy the desire of a growing public attention, Hogg wrote the three Autobiographical Letters already alluded to. They are all dated "Banks of Ettrick"; and the first, that of December 7,



1804, is unsigned. That of June 8, 1805, and that of September 15, 1805, are signed "Z". They are all written in the third person. These letters were revised into the connected narrative of 1807 prefixed to *The Mountain Bard*. Many minor details were stricken out and the whole rewritten in the first person. This memoir reappeared in 1821 when the third edition of *The Mountain Bard* was called for, and again in 1832 as part of Volume I of the *Altrive Tales*. Each version was brought down to the date of issue and differed from the former in the periods covered by each. The last contains several passages that are of a personal nature concerning the Shepherd's quarrel with Mr. Blackwood that have been omitted from editions published since the author's death. The *Autobiography* thruout is written in a bright, entertaining style, is full of trivial errors due to a faulty memory and the habit of exaggeration, and, of course, treats personal matters from the author's biased standpoint, and is colored everywhere by his inordinate vanity.

It is worth while to note that none of Hogg's best poetry was written deliberately for publication. His most memorable verse is always that which he "had by him at the time". *The Mountain Bard*, *The Forest Minstrel*—a complete failure and deservedly so—and his greatest work, *The Queen's Wake*, were volumes made up out of what he had already written, merely edited for the purposes of publication. Thus was composed the forgotten volume of the *Pastorals*, and all of them except parts of *The Forest Minstrel* show that natural spontaneity and flow of genius which is altogether absent from the longer poems composed after the poet became known as a man of letters.

This first important volume of Hogg's verse contains poetry of a very high order. It deals with personal matters or local legends which it treats in the ballad style; and Hogg's efforts in this form of imitation permit favorable comparison with Scott's. *Sir David Graem* is the best of this kind in the volume and is only not quite so good as *Kilmeny* and *The Witch of Fife* in *The Queen's Wake*. The telling effect of the refrain,

The dow flew east, the dow flew west,

and such ghastly images as that contained in the stanza:

There wasna sic e'en on the Border green,  
As the piercing e'en o' Sir David Graem;  
She glisked wi' her e'e where these e'en should be,  
But the raven had been there afore she came.



help to make this ballad the very essence of uncanny realism. Two compositions of a very different kind are *The Farewell to Ettrick* and *The Author's Address to his Old Dog Hector*. No shepherd is ever without his dog, but no shepherd, one fancies, ever loved dogs with a love like this shepherd. Dogs are on every page of his life and works. No tenderer, more sympathetic tribute of genuine affection for the four-footed companions of the hills ever flowed from the pen of a poet than this address to "my auld towzy, trusty friend". Hogg was ever a master of pathos, and his pathos sprang from his deepest heart. It was the sight of so many dead larks in a London market that inspired the most beautiful of all his lyrics. It is not surprising, then, that the thought of breaking all the old home ties on the occasion of the emigration to Harris should have prompted such a tender, touching *Farewell*. Were Hogg's reputation as a poet to rest upon the pages of *The Mountain Bard*, these three poems alone would constitute a sufficient claim to the title of a poet of true and varied power.

Hogg never possessed ready money without feeling a remarkable desire to "blow it in", if such slang be permitted, for no other phrase so well expresses the headless, exuberant, slapdash way in which he set about to spend his little fortune without consideration. He had acted thus in the Harris scheme in which he recklessly threw away all his earnings of ten years at Blackhouse; he repeated the experience now; and he was doomed to do it more than once again as the years rolled on.

Nothing would do but Hogg must set up as a farmer on his own responsibility as his father had unwisely done before him. Hogg seems to have been a trusty shepherd, but he possessed none of the canny Scotchman's talent for affairs. He expended all the fortune that he had derived from the publication of the two volumes, in a farm in Dumfriesshire that was far beyond his means to stock. It remained but half-stocked, and was also conducted in a careless way that from the first foretold ruin and destruction. Scott tells us that Hogg's partner was shiftless and given to drink; and here is a picture drawn by an eye-witness that not only shows the condition of affairs on the Shepherd's farm but also explains as well much of his inmost character.

Hogg from being a shepherd on the farm of Mitchel-Slack took, in company with Edie Brydon, the farm of Lockerben. When I paid a

second visit to Lockerben my pretty housekeeper was then gone. It was the time of sheep-shearing, which was just finished. Masters and men were sitting round a small cask of whisky, drinking it raw out of a teacup. They were all rather merry. I sat with them for some time and was regaled with some excellent mutton ham, cakes and butter, whisky and water. I had a surveying engagement at Moffat, about ten miles across a rough moor. A number of the company were going the same route. Mr. Brydon was of the party and fortified his pocket with a bottle of whisky, which was finished on our journey. I was obliged to attend to some papers for the greater part of the night, but I heard the distant sound of reveling. The establishment at Lockerben was soon after broken up—how could it stand?—and Mr. Hogg, with a small reversion took on lease a farm on the water of Scar, in the parish of Penpoint, about seven miles west from Lockerben. Corfardine was its name. I happened to be at Eccles with Mr. Maitland a few days, and one forenoon paid him a visit, distant about three miles. The ground was covered with snow; and, on entering the farm, I found all the sheep on the wrong side of the hill. Hogg was absent, and had been so for some days, feasting, drinking, dancing, and fiddling, &c., with a neighboring farmer. His housekeeper was the most ugly, dirty goblin I had ever beheld; a fearful contrast to his former damsel. He arrived just as I had turned my horse's head to depart.

"Come in", said he; "the lads will soon be home." The inside of his house corresponded with its out. A dirty looking fellow rose from a bed, who was desired to go and look after the sheep. "I have been up", he said, "all night in the drift." "You have been so", said I, "to very little purpose. Your hirsle is on the wrong side of the hill."

He ordered some ham and some bread and butter; but it came through such hands that I could not eat. Over our glass of whisky we had a long conversation. I strongly recommended him to give up his farm and come to Edinburgh, and attend to the publication of *The Mountain Bard*, which he said agreed with his own opinion, for that he had in contemplation a long poem about Queen Mary.<sup>5</sup>

Three years of this was enough. Then Hogg, having become a bankrupt, literally ran off from his creditors and appeared once more in the Ettrick country. His notion was to hire again as a shepherd, but no one would have him. The people of his native vale looked upon such foolish extravagance as not only sinful but absolutely criminal. They would have nothing to do with him. Wherever he went he met with the cold shoulder. All summer nothing was doing for him. At last he made the seemingly rash resolution of going to

<sup>5</sup> Morrison's *Reminiscences of Scott, Hogg, etc., Tait's Magazine*, Vol. 10, page 574. The reader will notice a slight slip as to dates in the above quotation. The article, which is very obscure as to dates, says "about this time, 1809" occurred the conversation referred to. *The Mountain Bard*, however, was published in 1807. Doubtless Morrison confused the above with some conversation that had taken place while Hogg was still at Mitchel-Slack.

Edinburgh to set up his shingle as a man of letters. He says in the *Autobiography* that he always intended to use literature as a crutch, never as a staff, and that he only violated his rule as a last resort. Hogg was certainly a genius, and at the time of his first appearance in Edinburgh as a permanent resident had won an enviable tho local fame as a poet. But he was a self-made genius, inordinately vain, not widely read, and possessed little or no critical ability. Yet, with all these points against him, his first serious venture was to edit and conduct a weekly literary journal. Nothing shows so well the real caliber of this man as the fact that he acquitted himself of this task with credit.

## CHAPTER 3

### THE ETTRICK SHEPHERD

HOGG's striking face was never handsome even tho he possessed so marked a likeness to Sir Walter Scott that Professor Wilson says that one would have thought them brothers. Yet the countenance of this shepherd was open, sincere, and thoroly manly despite its homeliness. He was a man of exceedingly strong physique and great endurance, a tramp over the mountains for thirty miles being a mere nothing in his estimation. In height he was five feet ten and a half inches, and broad chested. It is told that once in an assembly of considerable size the chests of all those present were measured, and his was the second, Sir Walter Scott being first. Later in life his hair became darker brown and then grayish, his eyes were blue and his complexion ruddy. He used regularly to compete at the outdoor athletic contests of the St. Ronan's games and always acquitted himself with credit.

Writes Mr. S. C. Hall some years later:

Up rose a man hale and hearty as a mountain breeze, fresh as a branch of hillside heather, with a visage unequivcally Scotch, high cheek bones, a sharp and clear gray eye, an expansive forehead, sandy hair with ruddy cheeks, which the late nights and the late mornings of a month of London had not yet sallowed. His form was manly and muscular, and his voice strong and gladsome, with a rich Scottish accent, which he probably on that occasion rather heightened than depressed.

Lockhart speaks thus of Hogg:

His hands and face are still brown as if he lived entirely *sub dio*. His very hair has a coarse stringiness about it, which proves beyond dispute its utter ignorance of all the arts of the *friseur*; and hangs in playful whips and cords about his ears in a style of the most perfect innocence imaginable. His mouth, which when he smiles nearly cuts the totality of his face in twain, is an object that would make Chevalier Ruspini die with indignation: for his teeth have been allowed to grow where they listed and as they listed, presenting more resemblance in arrangement (and color, too) to a body of crouching sharp-shooters, than to any more regular species of array. The effect of a forehead towering with a true poetic grandeur above such features as these, and of an eye that illuminates their surface with the genuine lightnings of genius . . . these are things which I cannot so easily transfer to my paper.



Hogg had many amiable characteristics and some that were less commendable. He was extremely careless, not only in business affairs but also in the details of his literary work. We have already seen how improvidently he embarked in the emigration scheme to Harris, and the deplorable waste in Dumfriesshire of what little money he had realized from *The Mountain Bard* and the book on sheep. Later in life when the Duke of Buccleugh kindly presented Hogg with the small farm of Altrive Lake rent free for life, nothing would do but he must embark in further ventures that brought again ruin upon him and his family. He rented the neighboring farm of Mount Bengier on the hillside above where now stands the Gordon Arms. He rented it against the advice of all his friends, sunk in it every penny he had, and, after a few years of struggle, returned to Altrive, once more a bankrupt. Still later, towards the end of his life, just after a publisher had failed, carrying with him what little hope of remuneration Hogg entertained at the time from a new literary venture, the Shepherd trusted the same publisher with a second work, and, had he lived a few months longer, the careless poet would have experienced another financial failure that practically threw the survivors of his family into temporary poverty. Many of these misfortunes were quite due to Hogg's misguided confidence in his own wisdom and to his arrogant refusal to take the friendly advice of those who were far better qualified to judge. But it should be said to his credit that his buoyancy of spirit rose superior to all calamity. Sometimes he was momentarily cast down, but depression with him was always short-lived. He generously blamed himself and never others, even when others were to blame. He would take the bull by the horns in a sturdy, robust fashion, set to work anew, and never wasted his time in vain lamentation over what could not be helped.

It is said that when he gave directions to the architect who planned the cottage at Altrive Lake he stipulated that the flues should be so constructed as to pass all the smoke out of one chimney. But this ruse, commendable in theory for the man who wished to convince his inquisitive neighbors that no one was at home save the occupant of the kitchen and thus preserve his time in quiet for literary work, was not successful in practice. Like Daft Jock, they found him out.

Before long Hogg's cottage was the gathering-place for all the Ettrick Forest and beyond, and we soon find the Shepherd, between his friends and Glenlivet, living far beyond his means. One of the most peculiar contradictions in this extraordinary man's character is the fact that he was one of the most careful, capable, and successful shepherds in the Forest, but in all other affairs of the farm and in his literary work he was shiftless in the extreme.

Some of his literary carelessness can be excused on the score of his lack of formal education. His knowledge of polite learning was derived wholly from his desultory reading without a guide that did not begin till he had reached the age of manhood. We have seen how a tricky memory led him to include many inaccurate assertions in the *Autobiography*. Scott accuses him of being utterly unfit for the task of historian and, by implication, unable to write successful historical novels. But Scott, great as he was, was not just the man to throw stones at such a house of glass, for he made no secret of the fact that he himself departed from the facts of history whenever the practice improved his story; and, in all probability, Scott's personal bias on one hand and Hogg's on the other led them to about equal excesses of laudation and damnation of the character of Claverhouse.

Never having been trained to study, Hogg could hardly be expected to prove an accurate investigator of the facts of history; but less venial is his failure to apply himself to the task of improving his literary style. Here, again, Scott, whose patient interest in the Shepherd's welfare withstood a thousand shocks, was always at him, reasoning, commanding, beseeching him to strive harder to do himself greater justice. Hogg was an extremely rapid composer, and much of his verse and most of his prose gives evidence of this fact. Scott's frequent advice to cut and to revise was never heeded by the head-strong shepherd. He rather boasts in the *Autobiography* of the fact that he never wrote a second draft of his manuscripts, a habit that sometimes occasioned an utter loss of a composition thru miscarriage in transportation. The utmost concession he would make to Sir Walter's well meant efforts at improvement was the resolution to do better the next time.

Hogg's vanity and egotism were so monumental as to be

amusing rather than condemnable. He was a living caricature in this respect. Scott writes of how Hogg dropped in to breakfast:

The honest grunter opines with a delightful *naïvete* that Moore's verses are far ower sweet—answered by Thompson that Moore's ear or notes, I forget which, were finely strung. "They are far ower finely strung", replied he of the Forest, "for mine are just reeght." It reminded me of Queen Bess, when questioning Melville sharply and closely whether Queen Mary was taller than her, and extracting an answer in the affirmative she replied, "Then your queen is too tall for I am just the right height."

He had a profound belief in himself and his powers,—a large share of egotism. His vanity was in no way concealed; he wore it on his sleeve, and it was a source of some amusement to his friends. But the consciousness under it all of a latent struggling power of genius was that which kept the heart in him to face the difficulties of social position, and defects of education, which few men in Scotland, or indeed in the world of letters, have had the courage to battle with and the force to overcome. The conviction was somehow in him from the first that he could achieve a place among the poets of his native land, and, while this feeling sustained him, it proved in the end to be well founded. His poetic faculty was his one title to distinction; and we need not be surprised that he was proud of it, or that he was touched to the quick by any disparagement of his powers.<sup>1</sup>

Hogg himself, in his life of Scott, uses the phrase, "before my ruling passion of egotism came across me". He fully realized the fact and the impossibility of conquering it, so he fondled it, got the most amusement he could out of it, and compelled others by the open simplicity of his character to do the same.

"Aye, ye're a learned man", he sometimes said to me in after years; "there's nae doubt about that, wi' your Virgils and Homers and Dantes and Petrarchs. But aiblins ye mind yon fragment upon the slate that ye despised t'ither morning. Eh, man, sin syne, it's ettling to turn out the vera best thing I ever composed; and that's no saying little, ye ken."<sup>2</sup>

In the same memoir Gillies relates that he wanted to see what Hogg had written on another occasion on his slate. The request was refused because the work was only half done, whereupon Gillies said that Scott and Erskine both consulted the advice of friends.

"That's vera like a man", replied Hogg, "that's frightened to gang by himself, and needs someone to lead him! Eh, man, neither William

<sup>1</sup> Veitch's Introduction to Mrs. Garden's *Memoir*, page ix.

<sup>2</sup> *Memoirs of a Literary Veteran*, by R. P. Gillies, Vol. I, page 122.

Erskine nor ony critic beneath the sun shall ever lead *mei*! If I hae na sense enuch to mak and mend my ain wark, no other hands or heads shall meddle wi' it; I want nae help, thank God, from books nor men."

Gillies adds:

The good Shepherd's vanity differed from that of all other authors, inasmuch as it was avowed and undisguised, and he himself laughed at it objectively as such.

So one might go on multiplying examples. The *Autobiography* alone contains many, and not the least is found in the whole conception of *The Poetic Mirror*, which will be described later.

Lockhart's description of Hogg's behaviour at Scott's dinner, and the account of Hogg's life in Dumfriesshire already quoted from Mr. Morris, bear witness to his conviviality. Hogg says himself in one place that he often drank enough whisky to make himself a fit object for seizure by the customs officers; but in another place he comes nearer the truth when he writes:

Sociality is so completely interwoven in my nature that I have no power to resist indulging it, but, I have been blessed by providence with a constitutional forbearance which prevents me from ever indulging in any sinful excess, a blessing for which, circumstanced as I am, I can never be too thankful.<sup>3</sup>

Hogg possessed an erratic, impatient temper that often led him into unnecessary difficulties. His quarrel with Blackwood could have been avoided, his grudge against Christopher North, one of his best and longest friends, was unfounded, and his one serious quarrel with Scott grew out of the trivial refusal to contribute to *The Poetic Mirror*. Hogg's anger, however, was quick to rise and quick to fall. Every fuss was eagerly patched up and he never bore the least malice towards those he had foolishly offended, a sure sign of a sober mind.

The Shepherd's code of honor was peculiar and amusing. The following quotations will bear insertion in spite of their length. The *Glasgow Chronicle* of May 12, 1818, contained the following paragraph:

Yesterday forenoon a gentleman from Glasgow, whose name had been imperceptibly introduced into *Blackwood's Magazine*, horsewhipped him opposite his own door in Princes Street. As this gentleman was stepping into the Glasgow coach, at four o'clock, Mr. Blackwood, armed

<sup>3</sup> Letter to Dr. Crichton, quoted by Mrs. Garden, page 230.



with a bludgeon, and apparently somewhat intoxicated, and accompanied by a man having the appearance of a shop porter, attempted a violent assault, but without injury, the attack being repelled and retaliated by the free use of the horsewhip. A crowd, attracted by the occurrence, speedily separated the parties.

Blackwood replied to this paragraph by a letter whose main point was to show that Douglas got far the worst of it, and Hogg wrote the following:

To the Editor of the *Glasgow Chronicle*,  
Sir,

A copy of the *Glasgow Chronicle* has just been handed to me, in which I observe a paragraph concerning Mr. Blackwood and a *gentleman from Glasgow*, which I declare to be manifestly false. The paragraph must have been written by that same *gentleman* himself, as no other spectator could possibly have given such a statement. Among other matters, he says that Mr. B. was "accompanied by a man having the appearance of a shop-porter". He is a *gentleman from Glasgow*, and I am "*a man having the appearance of a shop-porter*" (for there was no person accompanying Mr. B. but myself). Now I do not take this extremely well, and should like to know what it is that makes him a *gentleman* and me so far below one. Plain man as I am, it cannot be my appearance; I will show myself on the steps at the door of Mackay's Hotel with him whenever he pleases, or any where else. It cannot be on account of my parents or relations, for in that I am likewise willing to abide the test. If it is, as is commonly believed, that a man is known by his company, I can tell this same *gentleman* that I am a frequent and welcome guest in companies where he would not be admitted as a waiter. If it is to any behaviour of mine that he alludes in this his low species of wit, I hereby declare, Sir, to you and to the world, that *I never attacked a defenceless man who was apparently one half below me in size and strength, nor stood patiently and was cudged like an ox when that person thought proper to retaliate*. As to the circumstances of the drubbing Mr. Blackwood gave the same *gentleman from Glasgow*, so many witnessed it, there can be no mistake about the truth.

JAMES HOGG.

No. 6, Charles Street, Edinburgh,  
13th May, 1818.

Amusing as this exhibition of offended pride is, Scott in his *Journal* gives us another anecdote that puts the Shepherd's fierceness in quite a different light.

Our poor friend Hogg has had an *affair of honour*. . . . Two mornings ago about seven in the morning, my servant announced while I was shaving in my dressing-room, that Mr. Hogg wished earnestly to speak to me. He was ushered in, and I cannot describe the half startled,

half humorous air with which he said, scratching his head most vehemently "Odd, Scott, here's twae fo'k's come frae Glasgow to provoke me to fecht a duel." "A duel", answered I in great astonishment, "and what do you intend to do?" "Odd, I just locket them up in my room and sent the lassie for twae o' the police, and just gie the men ower to their charge, and I thocht I wad come and ask you what I should do. . . ." He had already settled for himself the question whether he was to fight or not, and all that he had to do was to go to the police and tell the charge he had to bring against the two Glasgow gentlemen. . . . The Glaswegians were greatly too many for him in court. . . . They returned in all triumph and glory, and Hogg took the wings of the morning and fled to his cottage at Altrive, not deeming himself altogether safe in the streets of Edinburgh! Now, although I do not hold valour to be an essential article in the composition of a man like Hogg, yet I heartily wish he could have prevailed on himself to swagger a little. . . . But, considering his failure in the field and in the Sheriff's Office, I fear we must apply to Hogg the apology that is made for Waller by his biographer: "Let us not condemn him with untempered severity, because he was not such a prodigy as the world has seldom seen—because his character included not the poet, the orator, and the hero."<sup>4</sup>

The Shepherd was jolly, self-made, and confident, and became in later life well-behaved in and thoroly conversant with the usages of society far above the rank in which he had been born. In his early days, however, he encountered many mishaps. It may be worth while here to quote the passage from Lockhart to which reference has already been made:

When Hogg entered the drawing-room, Mrs. Scott, being at the time in a delicate state of health, was reclining on a sofa. The Shepherd, after being presented, and making his best bow, forthwith took possession of another sofa placed opposite to hers, and placed himself thereupon at all his length; for, as he said afterwards, "I thought I could never do wrong to copy the lady of the house." As his dress at this period was precisely that in which any ordinary herdsman attends cattle to the market, and as his hands, moreover, bore most legible marks of a recent sheep-smearing, the lady of the house did not observe with perfect equanimity the novel usage to which her chintz was exposed. The Shepherd, however, remarked nothing of all this—dined heartily and drank freely, and, by jest, anecdote, and song, afforded plentiful merriment to the more civilized part of the company. As the liquor operated, his familiarity increased and strengthened; from "Mr. Scott", he advanced to "Sherra", and thence to "Scott", "Walter", and "Wattie",—until, at supper, he fairly convulsed the whole party by addressing Mrs. Scott as "Charlotte".<sup>5</sup>

<sup>4</sup> Scott's *Journal*, page 454.

<sup>5</sup> Lockhart's *Life of Scott*, page 111 (Black's edition, 1895).

### The Shepherd himself writes in his *Life of Scott*:

I must confess that, before people of high rank, he [Scott] did not much encourage my speeches and stories. He did not then hang down his brows, as when he was ill-pleased with me, but he raised them up and glowered, and put his upper lip far over the under one, seeming to be always terrified at what was to come out next, and then he generally cut me short by some droll anecdote to the same purport of what I was saying. In this he did not give me fair justice, for, in my own broad, homely way, I am a very good speaker and teller of a story, too.<sup>6</sup>

### Writes R. P. Gillies:

On one of these occasions, during dessert, the Shepherd was painfully puzzled, for, not having till then met with ice-cream in the shape (as he said) of a "fine het sweet puddin", he took incautiously a large spoonful, whereupon, with much anxiety and tearful eyes, he appealed to me:—"Eh, man, d'ye think that Lady Williamsen keeps ony whisky?" to which I replied instantly that I did not think but was quite certain on that point; accordingly the butler at my suggestion brought him a *petit verre* by which he was restored to entire comfort and well being.<sup>7</sup>

The social deportment of the Shepherd has been severely depicted and commented on by Mr. Lockhart, but the absence of conventional good breeding, at least in the earlier part of his life, is not to be wondered at, and the frankness of his confession and apology when made aware of any palpable transgression, more than atoned for such in the minds of his more generous friends. Take, for example, the following extract from a letter to my father:—"September 26, 1808. If you will be so kind as to impute my behaviour at this time to the effects of your own hospitality, and not to my natural bias, I promise—nay, I swear, never to offend you again in thought, word or deed." This promise was not kept, but the failure was acknowledged and repented of as we shall see.<sup>8</sup>

Hogg records that when he first conceived an ambition to follow in the footsteps of Burns he felt that he had more experience to write about "than ever ploughman had". It is true that he possessed an absolutely limitless knowledge of Border adventure and tradition. He had been raised among the most independent and sterling class of men upon British soil, and, being a shrewd observer, if not judge, of human character, his mind was stored with the material for fiction. He was fond of out-of-door life, and, tho he has left no such tender record as the anecdote that expresses Scott's love for the heather which he must see once a year or die, Hogg's frequent descriptions show his abounding love of nature. He

<sup>6</sup> Page 99.

<sup>7</sup> *Memoirs of a Literary Veteran*, Vol. 1, page 130.

<sup>8</sup> *Archibald Constable and his Literary Companions*, by his son Thomas Constable.

possessed especially the power of grasping for expression the crucial single detail of a scene, and his greatest descriptive power was in setting forth graphically such large changing scenery as is involved in the description of a lasting storm. The narrative of the great snow described in *Storms*, and of the terrible deluge of a cloudburst set forth in *Mr. Adamson of Laverhope* merit to be set side by side with the storms in *Copperfield* and *The Antiquary*.

He was crude but not rude in conversation.

. . . . a strange compound of boisterous roughness and refinement in expression, and these odd contrasts surprised strangers such as Moore and Ticknor. The former was shocked and the latter said his conversation was a perpetual contradiction of the exquisite delicacy of *Kilmeny*.<sup>9</sup>

Says Mrs. S. C. Hall, writing of Hogg late in life:

I can recall James Hogg sitting on the sofa—his countenance flushed with the excitement and the “toddy”—(he had come to us from a dinner with Sir George Warrender, whom some wag spoke of as Sir George Provender) expressing wild earnestness, not, I thought, unmixed with irascibility. He was then, certainly, more like a buoyant Irishman, than a sturdy son of the soil of the thistle, as he shouted forth in an untunable voice, songs that were his own especial favorites, giving us some account of each at its conclusion. One I particularly remember—“The Women Folk”. “Ha, ha!”, he exclaimed, echoing our applause with his own broad hands, “that song, which I am often forced to sing to the leddies sometimes against my will, that song never will be sung so well again by anyone after I am done wi’ it.” . . . I remember Cunningham’s comment, “That’s because you have the nature in you.”

The Shepherd’s love of children and of animal pets was so unbounded that one is instinctively reminded of Southey. His writings are full of tender tributes to dogs, and he was a keen sportsman, both fisher and hunter. He knew the Bible thoroly and possessed an abiding and trusting faith in the Almighty. He was superstitious, and certainly more than half believed the wild, mysterious tales in which he took such great delight. Dreams especially seemed to interest him and many of his best stories turn upon a vision during sleep. So much has been quoted in this brief description that sounds in print detractive, that the chapter may fittingly end with a few general opinions that drop the unusual and often amusing vagaries of his character and tell what general impression this remarkable man made upon his contemporaries.

<sup>9</sup> Scott’s *Journal*, page 448, footnote.



Among the few of many Scottish worthies of whom I give memories in these pages, surely I must not omit "the Ettrick Shepherd". How I should have enjoyed a day with him on the Braes of Yarrow. Even now, across all these years that I have passed, I can hear his hearty voice and jovial laugh, and see his sunburnt face not yet paled by a month of "merrie companie" in London. "I like to talk about myself", so begins his *Autobiography*. No doubt he was an egotist, but so is every shepherd when he talks of sheep; so is a mariner when he speaks of peril in sailing a ship; so are all men who dwell on matters which constitute their "personality", and which they understand better than others do. In short, so are all teachers. The accusation of egotism, and also that of plagiarism, are easily made, but are not so easy of proof. Few men have thoroughly triumphed over difficulties; none came more triumphantly out of them. James Hogg was a more marvellous man than Robert Burns; far less great as a poet, certainly; but marvellous in the dauntless energy with which he struggled against circumstances, yet more adverse than those of Burns, and reached—not an untimely grave, but a secure position in the world of letters. Hogg was as much as Southey "a man of letters by profession"; and surely one of the most remarkable men of the century that passed away when

"Ettrick mourned her shepherd dead."

A wrestle with fortune, indeed, was his! chequered yet successful, and marked during the whole of his fairly long life by good spirits, that were partly the result of a good constitution, and greatly, perhaps, derived from his sanguine self-esteem.

I remember one of the evenings he passed with us . . . . The visit of the Ettrick Shepherd to London took place in 1832. It is scarcely too much to say that the impression he produced in literary circles may be likened to that which might have been created by the temporary presence of Ben Nevis on Blackheath. A striking sight it was to see the Shepherd fêted in aristocratic *salons*, mingling with the learned and polite of all grades—clumsily, but not rudely. He was rustic without being coarse; not attempting to ape the refinement to which he was unused; but seemed perfectly aware that all eyes were upon him, and accepting admiration as a right.<sup>10</sup>

But it does not appear that his resentment was either deep or long-continued, though he speaks of never being able to forgive Wordsworth. Hogg was essentially a kindly, generous, and warm-affectioned man, capable of attaching to himself friends of very opposite characters; genial in society though not a brilliant or copious talker, and, in his own home at Altrive and Mount Benger, hospitable almost to a fault. Obviously, too, he was a loving and well-loved man in his home circle, where he found his best happiness. His shrewd views of people and things, and his quaint modes of expression, redolent of the vernacular of the Forest and tinged with poetry,—in a word, the singular individuality of his character made him an object of interest to numerous friends and acquaintances all over Britain.<sup>11</sup>

<sup>10</sup> S. C. Hall.

<sup>11</sup> Professor Veitch.

While thus recalling for the amusement of an idle hour, some of the whimsical scenes in which we have met James Hogg, let it not be supposed that we think of him only with a regard to his homely manners, the social good nature, and the unimportant foibles by which he was characterised. The world amid which he moved was but too apt, especially of late years, to regard him in these lights alone, forgetting that beneath the rustic plaid there beat one of the kindest hearts and most unperverted of minds, while his bonnet covered the head from which sprung *Kilmeny* and *Donald MacDonald*. Hogg, as an untutored man, was a prodigy, much more so than Burns, who had comparatively a good education; and now that he is dead and gone, we look around in vain for a living hand capable of waking the national lyre.<sup>12</sup>

We remember among the things of this life that are worth remembering, his sturdy form, and shrewd, familiar face; his kindly greetings, and his social cheer, his summer angling, and his winter curling, his welcome presence at kirk and market, and Border game, and, above all, we remember how his gray eye sparkled as he sang, in his own simple and unadorned fashion, those rustic ditties in which a manly vigor of sentiment was combined with unexpected grace, sweetness and tenderness.<sup>13</sup>

There was a homely heartiness of manner about Hogg and a Doric simplicity in his address, which was exceedingly prepossessing. He sometimes carried a little too far the privileges of an innocent rusticity, as Mr. Lockhart has not failed to note in his life of Scott; but, in general his slight deviations from etiquette were rather amusing than otherwise. When we consider the disadvantages with which he had to contend, it must be admitted that Hogg was in all respects a very remarkable man. In his social hours, a naïvete, and a vanity that disarmed displeasure by the openness and good-humour with which it was avowed, played over the surface of a nature which at bottom was sufficiently shrewd and sagacious; but his conversational powers were by no means pre-eminent. He never indeed attempted any colloquial display, although there was sometimes a quaintness in his remarks, a glimmering of drollery, a rural freshness, and a tinge of poetical coloring, which redeemed his discourse from commonplace, and supplied to the consummate artist who took him in hand the hints out of which to construct a character<sup>14</sup> at once original, extraordinary, and delightful—a character of which James Hogg undoubtedly furnished the germ, but which, as it expanded under the hands of its artificer, acquired a breadth, a firmness and a power to which the bard of Mount Benger had certainly no pretension.<sup>15</sup>

<sup>12</sup> Robert Chambers.

<sup>13</sup> Henry Glassford Bell.

<sup>14</sup> Refers to the Ettrick Shepherd in the *Noctes Ambrosianae*.

<sup>15</sup> Ferrier.

## CHAPTER 4

### RESIDENCE IN EDINBURGH

THE man whose character has been sketched in the preceding chapter set out, as has been related, to make his fortune in the capital as a man of letters. Enough has been already said to show how unsuited he was by training for the task he had undertaken. He had but few friends in the city and none who could be of much use to him. The better part of a year passed and he was unable to make any money; and, had it not been for the hospitality of an acquaintance he would have been in great practical straits at this time.

After much solicitation Mr. Constable was persuaded to undertake the publication of another volume of verse. *The Forest Minstrel*, as it was called, was dedicated to Lady Dalkeith, who sent Hogg, in consequence, a present of a hundred guineas; but this was all the profit he ever received. The book fell flat; and, in this case, the popular verdict was just criticism. For some years the Shepherd's time had been so taken up with his disastrous experiments in agriculture that he had had no time to write verse.

He had drawn upon the best of what he calls his "youthful songs" when he published *The Mountain Bard*, and he had but the refuse left to form into a new volume. There are some stanzas of merit to be found in *The Forest Minstrel* and some of the poems are better than others; but, on the whole, one does not find any difficulty in comprehending the contemporary unpopularity of the book—a judgment that time has not reversed.

Yet the poet who had just made such a failure was not to be put down by bad luck. His indomitable spirits and unlimited egotism came nobly to his rescue. If Mr. Jeffrey could conduct a review, why could not he, James Hogg, do the same with a weekly journal of literature and criticism? So, likely, he reasoned to himself. At any rate, he resolved to undertake such a task and *The Spy* resulted. To ordinary readers *The Spy* is quite inaccessible, there being not above half a dozen copies in existence, if there be so many. Therefore the present writer feels justified in commenting upon it in detail; for, in his opinion, it constitutes the Ettrick Shepherd's highest claim, if not to fame, at least to our admira-

tion for his character. We must remember, while reading the following extracts, that they were written by a man almost wholly unlearned, wholly undrilled, one who had educated himself, one who was suffering from actual privation and trial, not to speak of the bitter disappointment of futile hopes. Yet he wrote nearly every word of a weekly journal that ran successfully for a year, and which, had he but possessed a little more tact, would probably have developed into a successful venture.

He had much difficulty in getting started. No publisher would lend his name to the undertaking, and Hogg found it almost impossible to obtain a printer. At last he did secure one with whom he used to make his business arrangements over a glass of whisky in a mean tavern in the Cowgate. Hogg soon fell into bad habits, and his paper began to go down rapidly; but he had the good sense to see that this sort of thing would not do. He made a sudden resolve to break with his printer. Luck for once seemed to be with him. He immediately found another and, after No. XIV., we find the imprint of A & J Aikman, at The Star Office.

The paper sold for fourpence, and almost immediately Hogg possessed a subscription list that made his journal profitable. A perusal of *The Spy* would not only have saved one of Hogg's recent biographers from an amusing blunder in which he acknowledges never having heard of one of the Shepherd's most attractive fictions, but also affords the reader much entertainment and a complete insight into the mechanical details of much of Hogg's writing. There we find many papers often republished under different titles in later volumes; mere sketches that were later expanded into stories; and a succession of amusing adventures, quite disconnected and episodic in character, which were subsequently joined together in one long story. It is true, however, that *The Love Adventures of Mr. George Cochrane*, that thus came into existence, showed little, if any, constructive improvement.

The first number of *The Spy* contained a full and detailed account of the editor, an account, however, which is wholly fictitious, for Hogg was concerned to keep his connection with the paper an utter secret. With the fourth issue Hogg got into trouble. In one of the stories, a farmer, who tells his own adventures in a gay, trifling manner, seduces his serving-maid and continues to live with her as his mistress. The com-



motion this episode produced among the straight-laced dames of Edinburgh testifies to the warm reception the new periodical had received. An unknown sheet could never have raised such a nest of hornets. Their buzzing and stinging soon made Hogg perfectly aware of the error he had committed against propriety. The exercise of a little tact, a courteous withdrawal, and a promise for the future cleanliness that Mr. Wesley had rated so highly—and all might still have been well. But the editor was stubborn. He decided that he was the best judge of what should go into his weekly quarto. In any case, he reasoned, the story was not so very objectionable. So he persisted. It was not till the subscription dwindled lamentably that Hogg dropped the objectionable tone and purged his publication. It was too late. Ruin had been already wrought. From this point, so early in its career, the fate of *The Spy* was sealed. Hogg realized that it had become a mere question of how long he could keep himself afloat. The struggle against adversity nerved him to some of his finest lyric poetry, as well as short tales in prose. We find the first draft of *A Peasant's Funeral* and *The Dreadful Story of McPherson*; such lyrics as *The Fall of the Leaf*, *Poor Little Jessie*, *Fair Was Thy Blossom*, etc., etc.; as well as a series of articles that deserve special mention.

*Mr. Shuffleton's Allegorical Survey of the Scottish Poets of the Present Day* was also offensive, but from a very different reason than that which halved the circulation. Mr. Shuffleton was a show-master who brought puppets upon the stage to dance for the public. These puppets were meant to represent the editor's fellow-poets. The man who could write that wonderful literary forgery, *The Poetic Mirror*, must have been a keen observer of style even if not a sane critic. It was the accuracy of the burlesque puppets that gave such widespread offense. Here is Hogg's description of himself:

The music now changed to a strain a great deal more simple [the preceding puppet represented Campbell] but perfectly regular, and still very sweet. As soon as I heard it I formed to myself an idea of what kind of a figure was next to be presented to our notice. We were not kept long in suspense. A country looking girl soon entered, whose countenance exhibited a good deal of sweetness and animation; and she was dressed in what she supposed would pass for the most elegant simplicity. Had her dress been equally elegant, and her ornaments rightly arranged, she might have passed for a beauty in her degree; but unfortunately this was not the case. The great circle of spectators

having been so dazzled with the splendor of the last two ladies [Scott and Campbell] did not deign to look on this with so much attention; not one appeared to view her with contempt, but only a few took particular notice of her, and these few seemed highly pleased with her. At her first entrance she was dressed in a mantle, somewhat resembling the dress of the first lady [Scott] but, finding that it rather encumbered her, she threw it off and appeared in the dress of a native shepherdess, which became her a great deal better. In this garb she accompanied the music with her voice, which indeed was melodious; and observing that this by degrees drew the attention of the crowd, she sung a great many of her native airs, which she performed with spirit and considerable facility; at one time falling into true, simple pathos, at another melting into the tender love ditty, and again bursting into a merry and comic strain.

I had been listening with so much attention to this minstreless of the mountain, that I had not till now observed that she was attended by an old faithful colly which she seemed very anxious should be taken notice of. This made her rather the more interesting: and I must say of her, what cannot be said of all these ladies, that, in proportion to the minuteness of our inspection, our good opinion of her increased. The main body of the crowd still remained insensible to her charms, or, if they really admired her, would not acknowledge it, as thinking it rather below them to seem interested in a girl so low bred.

"What a pity it is", said I, "Sir, that this girl is not more attentive to her dress, which is more singular as she does not seem to want taste." "A self-willed imp", said he, "who thinks more of her accomplishments than any other body does; and, because her taste is natural, thinks it infallible, and every person wrong who does not acquiesce in her opinion. Pray make the observation to herself, and see how ill she takes it." "Shepherdess", said I, "you little know what a blemish you throw upon one of the sweetest creatures in the world by that marked and affected negligence of dress" (for I wished to begin softly with her). She made a slight and awkward curtsy: "I think I sude ken as weel as you, or ony like ye, what suits my ain form an features", said she tartly; and looking back addressed her dog: "Come away, my poor fellow; you an' me disna mak a good appearance amang a' these pridefu' fock." So saying, she vanished in a moment. "She is hurt", said my friend, "and I am glad to see it: guilt never appears so evident as by the person taking it ill when charged with it; and the first and best mark of reformation is conviction. I will lay any bet that this shepherdess will pay more attention to the regularity and elegance of her dress in future, and learn by experience that cooks must not always make dishes to their own taste."

Enough of Mr. Shuffleton. *The Spy* continued to appear and the incessant labor of writing so many pages was just the sort of practical drill the Shepherd needed. Had he not had this year of experience he could never have written the novels, some of which are known in certain parts of the Border almost

as well as Scott's. But, as has been said, the paper was doomed. There is something dramatic in the fact that it died on the anniversary of its birth. Just one year of life was all that befell *The Spy*. And there is much that is pathetic in the shepherd's earnest, withal dignified, farewell to his readers. He was no longer anxious to conceal his secret and he talked plainly of his defeat in manly terms. No edition of Hogg's works should be published without including, at least, the last number of *The Spy*; and, as all but the name of this publication seems to have escaped the interest of editors and biographers alike, the present memoir will present a few additional extracts:

His [*The Spy's*] efforts have, without doubt, met with at least as much encouragement as they deserved; he frankly acknowledges that the encouragement has not been much to boast of; as his name became known the number of his subscribers diminished. The learned, the enlightened, and polite circles of this flourishing metropolis, disdained either to be amused or instructed by the ebullitions of humble genius; enemies, swelling with the most rancorous spite, grunted in every corner; and from none has *The Spy* suffered so much injury and blame, as from some pretended friends, who were indeed liberal in their advice, and ardent in their professions of friendship, yet took every method in their power to lessen the work in the esteem of others, by branding its author with designs the most subversive of all civility and decorum, and which, of all others, were the most distant from his heart. . . .

There have still, however, been a few, and not a very few either, who have stood *The Spy's* most strenuous advocates through good report, and through bad report. Of these he has been careful to preserve the names, and these names he will ever cherish with the most grateful remembrance; and were he certain they would regret the discontinuation of *The Spy*, and feel the same disappointment on missing it on a Saturday evening, that they would do on being deprived of an old friend or dependent, whose conversation, though not without faults, was become familiar and dear to them, he would, in his turn, experience sensations such as none save an enthusiast in the pursuits of literature can enjoy; and he may surely be allowed to indulge the hope so congenial to the soul of every candidate for literary honours, that the awards of posterity will in part justify that cause which his friends have maintained against such odds. They have had, at all events, the honour of patronising an undertaking, quite new in the records of literature; for that a common shepherd that never was at school, who went to service at seven years of age, and could neither read nor write with accuracy when twenty, yet who, smitten with an unconquerable thirst after knowledge, should run away from his master, leave his native mountains, and his flocks to wander where they chose, come to the metropolis with his plaid wrapped about his shoulders, and all at once



set up for a connoisseur in manners, taste, and genius, has certainly much more the appearance of romance than a matter of fact. Yet a matter of fact it certainly is, and such a person is the editor of *The Spy*.

He, indeed, expected no indulgence on that score, which he testified by giving his papers, even to his intimate acquaintances, anonymously; . . . his first printer and publisher did not even know who the editor was. . . .

He is, however, willing to believe, that these considerations will account in part for some inadvertencies that raised such a prejudice against *The Spy* on its first outset. It is hoped the candid reader will easily discover that these never have proceeded from the slightest intention of injuring the cause of virtue and truth, but either from inattention or mere simplicity of heart. . . .

Thus far may be said in justification of those papers that in no one instance is the cause of religion, virtue, or benevolence injured or violated, but always encouraged, however ineffectively; therefore, though *The Spy* merits not admiration, he is at least entitled to kindness for his good intentions. . . .

The papers which have given the greatest personal offence, are those of Mr. Shuffleton, which clamour obliged the editor reluctantly to discontinue. Of all the poets and poetesses whose works are there emblematically introduced, one gentleman alone stood the test, and his firmness was even by himself attributed to forgiveness; all the rest, male and female, tossed up their noses, and pronounced the writer an ignorant and incorrigible barbarian. The *Spy* acknowledges himself the author of these papers, and adheres to the figurative characters which he has there given of the poetical works of these authors. He knows that it is expected in a future edition that they will all be altered—but they never shall—though the entreaties of respected friends prevailed on him to relinquish a topic which was his favorite one. What he has published, he has published; and no private considerations shall induce him to an act of such apparent servility, as that of making a renunciation; and those who are so grossly ignorant as to suppose the figurative characteristics of the poetry, as having the smallest reference to the personal characters of the authors of these poems, are below arguing with. . . .

The character of a writer, especially of a periodical writer, has at least ten chances for being blasted for one of attaining eminence. He solicits the regard of a multitude fluctuating in pleasures or immersed in business, without time for intellectual amusements. He appeals to judges overpossessed by passions, or corrupted by prejudices, which preclude their approbation of any new performance. Many are too indolent to read anything till its reputation is established, others too envious to promote that fame which gives them pain by its increase. What appears new is opposed, because most are unwilling to be taught; and what is known is rejected, because it is not sufficiently considered, that men more frequently require to be reminded than informed. The learned are afraid to declare their opinions early, lest they should put their reputation to hazard; the ignorant always imagine themselves giving some proof of delicacy when they refuse to be pleased; and he



that finds his way through all these obstructions, must acknowledge that he is indebted to other causes besides his industry, originality, or wit. . . .

Surely, he that has been confined from his infancy to the conversation of the lowest classes of mankind, must necessarily want those accomplishments which are the usual means of attracting favor; and, though truth, fortitude, and probity may be supposed to give an indisputable right to respect and kindness, they will not be distinguished by common eyes, unless they are brightened by elegance, but must be cast aside as unpolished gems of which none but the artist knows the intrinsic value. . . .

The world has a thousand times witnessed what mighty things can be accomplished by the assistance of learning, but it has never yet ascertained how much may be accomplished without it. The pleasure, then, of making the experiment, though in a branch of literature that some may ridicule, and others despise, offers him sufficient inducement for perseverance. The chief art of attaining eminence in anything, is to attempt little at a time. The widest excursions of the mind are made by short flights often repeated; the most lofty fabrics of science have been formed by the continued accumulations of single propositions—the Spy may be worsted—he shall never be discouraged.

Hogg's next venture was to form a public debating society called the Forum. Its history is fully set forth in the *Autobiography* and need not be set down here. To the Forum, Hogg attributed much of his skill of feeling the public pulse, a trait he believed himself to possess in an eminent degree, but of which he gave little evidence. Some of the amusing incidents concerning this society gave rise to the *Forum, A Tragedy for Cold Weather*, which, however, was never published. It was at the Forum that Hogg became acquainted with a Mr. Goldie, who subsequently published *The Queen's Wake*, and whose sudden failure constituted another link in Hogg's chain of financial disaster. At this time (1812) a few copies were printed of *The Hunting of Badlewe*, under the nom de plume of J. H. Craig, of Douglas, after which Hogg gave up writing for the stage. Subsequently, however, he put forth, in 1817, two volumes of *Dramatic Tales*, which were merely dramatic dialogues untrammelled with dramatic structure. They neither merited nor received attention.

Hogg's personal acquaintance was steadily growing among the literary lights of Edinburgh, among which class, however, no one yet thought of classing him. *The Isle of Palms* appeared in 1812, and Hogg's enthusiastic review of this poem brought him into contact with Christopher North, whom he

visited at Ellaray many times in subsequent years. The acquaintance thus begun between the Shepherd and Professor Wilson was sincere, and, with one short exception, lasting. The white-haired professor of philosophy was the most striking figure as well as the most affected mourner in that slow train that wended its way twenty years later, along the Heart Leap Road, down by Tushielaw to Ettrick Kirk. Thru Wilson's means grew up a friendship between Hogg and Robert Southey; also an acquaintance with Wordsworth; but the poet of Rydal Mount on one occasion spoke contemptuously of Hogg's power as a poet and Wordsworth was never forgiven by the touchy Shepherd.

The fate of *The Forest Minstrel* had not discouraged Hogg. He now became desirous of publishing another volume of verse. He had recently written a good deal, and, rather than lose it, hastily joined it together into a long narrative poem of very loose structure. The story of *The Queen's Wake* is simple: Mary Queen of Scots arrives in Scotland and decides to have a poetic contest in which all the bards of Scotland are to take part. They meet, contest for three days, and the victor is judged. The major part of the production consists of the songs sung by the bards. It was merely as a pretext for joining together these already-written songs that Hogg hit upon the plan of the Wake.

The history of its publication may be told here to the end. Constable agreed to the undertaking. Goldie, of Forum acquaintance, gave a better offer; Hogg transferred the volume and offended Constable in consequence. The book was a tremendous success and made Hogg instantly famous; but, before he had reaped any pecuniary benefits Goldie failed and Hogg became bankrupt. Yet this misfortune was not wholly without its advantage for it was in the capacity of one of Goldie's executors that Mr. Blackwood was introduced to the Shepherd.

One finds in this poem many false rhymes. Doubtless Hogg justified himself in this practice by the similar fault in the poetry of his idol, Scott. The verse of *The Queen's Wake* is far more monotonous than Scott's, the Shepherd not having learned the advantage to be derived from variety of rhyme and meter. In the course of the poem Hogg often clumsily refers to himself, and there are other minor faults. Yet, in spite of these, one bows in wonder and admiration before such a poem or series of poems from such a man. Queen Mary is

brilliantly described on her return to Scotland from France. One of the finest qualities is the description of each bard that precedes his song. Each one is thoroly different from all the others, and is not only vividly painted but also in complete harmony with the tone of the song he sings. Above all, *The Queen's Wake* contains the two songs upon which Hogg's reputation as a poet could rest alone and not diminish. *Kilmeny* and *The Witch of Fife* are not only the best of Hogg's productions, but the best of the kind in our language. No one has ever touched the supernatural so supernaturally. No wonder that Hogg sprang with one leap into renown! All Edinburgh read the poem breathlessly. Everyone wanted to know the author of *Kilmeny*. People asked themselves how it happened that he had been among them all this time like a light under a bushel. They began to recognize at this tardy hour the excellence of *The Spy*. People shook the Shepherd by the hand, invited him to their houses, and showed him off.

At last, in the following year, *The Edinburgh Review* published an article from which the following quotation is taken. From the date of this criticism Hogg may be considered as an established man of letters.

It ought also be recorded to his honour that he has uniformly sought this success by the fairest and most manly means; and that neither poverty nor ambition has been able to produce in him the slightest degree of obsequiousness towards the possessors of glory or of power; or events subdue in him a certain disposition to bid defiance to critics and to hold poets and patrons equally cheap and familiar; and to think that they can in general give no more honour than they receive from his acquaintance. These traits, we think, are unusual in men whom talents have raised out of a humble condition of society—especially when they are unaccompanied as in the present instance, either with any inherent insolence of character, or any irregularities of private life; and therefore we have thought it right to notice them. But at all events, the merit of the volume before us, is such as to entitle it to our notice; and as the author has fairly fought his way to that distinction, we are not disposed to withhold from him either the additional notoriety that it may still be in our power to bestow, or the admonition that may enable him still further to improve a talent that has already surprised us so much by its improvement. . . .

Mr. Hogg has undoubtedly many of the qualifications of a poet—great powers of versification—an unusual copiousness and facility in the use of poetical diction and imagery—a lively conception of natural beauty—with a quick and prolific fancy to body forth his conceptions. With all this, however, he is deficient in some more substantial req-

uisites. There is a sensible want of incident, and character, and pathos, about all his compositions. . . .

Mr. Hogg's *forte* consists in the striking representation of supernatural occurrences, or of the more imposing aspects of external nature:— and we certainly consider his narratives of less marvellous events, as of inferior merit. His descriptions, however, are always brilliant and copious; though frequently drawn out to such a length, as to become in some degree tedious and languid.<sup>1</sup>

Commendation poured in fast from all sides. His brother poets welcomed him. Southey was enthusiastic. Scott befriended him more than ever. Mr. Blackwood was such a successful executor of Goldie's affairs that Hogg eventually made a neat sum out of the sale of the book. So, in every way, Hogg had good reason to look upon his Edinburgh sojourn with the pride of success achieved under the greatest of difficulties.

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<sup>1</sup> *Edinburgh Review*, November, 1814, page 151, etc.



## CHAPTER 5

### LIFE AT ALTRIVE LAKE

IN the summer of 1814 Hogg, while upon one of his numerous trips to the Highlands, was for some time laid up with a cold at Kinnaird House in Athole, the residence of Mr. Chalmers Izett. It was while here that Mrs. Izett proposed to Hogg that he do something to "prevent his mind from rusting". The result of this suggestion is *Mador of the Moor*, a poem that contains much commendable description, but of which the structure is so loose and the matter so commonplace that it adds little or nothing to its author's reputation. At the time, however, it was passably well received, and Hogg was gratified by the following letter<sup>1</sup> from the Duke of Buccleugh:

Penrich, May 7, 1816.

Sir,

I return you my thanks for your present of *Mador of the Moor*. This poem has gratified and amused me much. I do not pretend to be a critic, or judge of poetry in proportion to the interest it creates in me. I shall therefore only add that *Mador* shall be immediately re-read as soon as the different individuals of my family shall have perused it, a period at no great distance.

Your friend and well-wisher,

Buccleugh, &c.

Hogg's celebrity was now sufficient to warrant the painting of a portrait. Nicholas was at work upon it in 1815; and on St. Valentine's Day Hogg addressed a letter<sup>2</sup> to his friend Laidlaw.

Dear Laidlaw,

If I cannot procure Lion before this day eight days, I am positively condemned to sit ages and centuries in company with a butcher's collie, in the town, as unlike my strumpit whelp as I to Hercules. If you can submit to this, why, then, I must; but positively I shall never look at my own picture. If I were to come myself I have no time to stay, for the artist says he would not that my picture were not in the exhibition this year for 50 pounds, and he cannot give it a tone until the figures are adjusted. Two nights and a day are quite sufficient for Rob to stay here, and in that case he will get the dog home with him.

Yours ever.—J. H.

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<sup>1</sup> Published by Mrs. Garden, page 106.

<sup>2</sup> Quoted by Mrs. Garden, page 83.

Mrs. Garden quotes another interesting letter, which not only alludes to Hogg's next important work, *The Poetic Mirror*, but also details in amusing fashion his relation to Lord Byron.

London, April 10, 1815.

My Dear Friend,

I entreat you not to ascribe to inattention the delay which has occurred in my answer to your kind and interesting letter. Much more, I beg you not to entertain for a moment a doubt about the interest which I take in your writings, or the exertions which I shall ever make to promote their sale and popularity. I can express no word of praise equal to my estimation of the *The Queen's Wake*, which is, I believe, not less admired by all who have read it. . . .

They are each selling every day, and I have no doubt that they will both be out of print in two months. It is really no less absurd than malicious, to suppose that I do not advertise, and by every other means strive to sell these works, in which I am so much interested.

Respecting the collection of poems, I really think Lord Byron may, in a little time, most certainly be relied on as a contributor. He continued to be exceedingly friendly to you in all respects; and it will be reciprocity of kindness in you to make large allowance for such a man. Newly married—consider the entire alteration which it has occasioned in his habits and occupations, and the flood of distracting engagements and duties of all kinds which have attended it. He is just come to town, and is in every respect, I think, very greatly improved. I wish you had been with me on Friday last, when I had the honour of presenting Scott to him for the first time. This I consider as a commemorative event in literary history, and I sincerely regret that you were not present. I wish you had dashed up to London at once, and if you will do so immediately, I will undertake to board you, if you will get a bed, which can easily be obtained in my neighborhood, and everybody will be glad to see you.

Could you not write a poetical epistle, a lively one, to Lady Byron, congratulating her on her marriage? She is a good mathematician, writes poetry, understands French, Italian, Latin, and Greek—and tell her that, as she has prevented Lord Byron from fulfilling his promise to you, she is bound to insist upon its execution; and to add a poem of her own to it by way of interest. She is a most delightful creature, and possesses excellent temper and a most inordinate share of good sense. . . .

Your faithful friend

Jno. Murray.

Mr. James Hogg.

In this year occurred another momentous change in the Shepherd's life, namely, his permanent return to the vale of Yarrow. Shortly before, he had dedicated *The Forest Minstrel* to the Duchess of Buccleugh, not without hope of patron-

age more substantial than gratitude. Hogg imagined that this hope was utterly beyond fulfilment when the news reached him of the Duchess's death in August, 1814. The good woman, however, had not forgotten the poetic shepherd of her husband's dukedom. Her dying request was in behalf of Hogg, a request that was answered by the Duke's grant to Hogg, rent free, of the small farm of Altrive Lake.

Hogg wrote on January 29, 1815:<sup>3</sup>

Dear Laidlaw, the weather seems so uncertain and broken that I believe I must postpone my journey to Traquair, and for some time, although Nicholson is out of all patience for the dog, and was perfectly in raptures when he heard that I was coming out for him. It is strange that I cannot get him in.

You have won your shilling. There was scarcely one-third of the club counted above me in our play for the medal. . . . With regard to the making of my new curling stones, you need not much mind until we see where we are to play next year, for yesterday I was waited on by Major Riddell (the Duke's factor) who delivered me a letter from the Duke of Buccleugh, granting me in the most kind and flattering manner the farm of the Moss-end (Altrive Lake), without any rent, or with what his Grace calls a nominal rent. The Major was extremely polite, and said that he had never been commissioned to confirm any grant that gave him more pleasure, and that he wished much to be better acquainted with me. He said it was a pity it was not better worth my acceptance, but that it was the only place vacant, and would do for the present as a retreat. He mentioned the exchange with the Craig, which was to take place, and said that whatever fell to the Duke's share, would of course fall to me. This I knew would be a mistake but as "a gi'en horse sudna be lookit i' the mouth" I only said that with all these arrangements I would take no concern. I have written to his Grace to-day, shortly acknowledging the benefit conferred. You must get word to my father who will be very uneasy.

Yours truly,

James Hogg.

On May 7, 1815, Hogg took possession of the farm he was to occupy, with the exception of one short removal to an adjacent farm, till his death. The cottage itself was in a woeful state of disrepair, so open, in fact, that when visitors came, "All the plaids were hung up around the door as a screen from the cold." Here he lived for some time with his aged father (his mother had died at Ettrickhall in 1813) and a country servant-maid whose "rusticity must often have amused some of his more fastidious friends". (Mrs. Garden.)

<sup>3</sup> Quoted by Mrs. Garden, page 81.

Before long he set about the task of building a new cottage, the need of which is shown by the following:

On Tuesday morning I walked to Hogg's, a distance of about eight miles, fishing as I went, and surprised him in his cottage bottling whisky. He is well and dressed pastorally. His house is not habitable, but the situation is good, and may become pretty. There being no beds in his domicile, we last night came here, a farmer's house about a quarter of a mile from him, where I have been treated most kindly and hospitably.'

Hogg's one injunction to the architect of the new cottage was so to design the building that all the smoke would come out of one chimney. His sudden access of fame had subjected him to a press of visitors, "trippers" we should call them now, and his architectural suggestion was his way of fooling them into the notion that no one was at home save the occupant of the kitchen. His brilliant idea, however, was not successful, and, before long, Altrive Lake became the constant meeting-place of all the intellectual men of the Scottish Border: truly a Mermaid tavern in the midst of Elysian Fields.

The country round about Yarrow was even more isolated in those days than it is at present. He writes in 1819:

I see your letter is of old date, and yet it is several days since I got it; but at this season I am quite secluded almost from the possibility of communication with this world, it being only by chance that I get my letters at all; and I do not even know if I shall get this away to the post.

In fact, the usual way of reaching Altrive Lake from Edinburgh was by the Peebles Coach to Peebles, then a six-mile journey to Innerleithen, and the remaining seven miles, often afoot to Altrive. Until many years subsequent to this time there were few, practically no, carriage roads in either the Ettrick or Yarrow valleys.

The first gig ever introduced into Yarrow parish was that of Mr. Thomas Milne, who came as tenant to Dryhope in 1812. He was lame and could not ride, and such an unusual luxury was for that reason excused in a farmer. . . . The farm houses were thatched, small, and low-roofed. They were on one model—a room in one end, the kitchen in the other, and through the kitchen another room used as a bedroom, with, perhaps, two small attics above, reached by a trap ladder, and lighted by a few small panes through the thatch. I remember Ladhope, Mt. Bengier [later occupied by Hogg], Newhouse, and Newburgh, being in this style. . . . The cottages for the hinds and shepherds were little better than dark smoky hovels. Their walls were of

<sup>4</sup> Letter from Wilson to his wife.



alternate rows of stones and sods, their floor of earth, and their roof of coarse timber covered with earth and rushes. A hole in the middle or end of the roof, surrounded at the top by a wicker frame widening as it came down, plastered with a mixture of straw and mud, and supported by a strong beam, was the only chimney. If the rain or snow occasionally found entrance through this open space, it allowed of a number of persons gathering round the glowing peat fire, and was convenient for smoking hams. A small aperture with a single pane of glass, and sometimes altogether open, was stuffed at night with old clothes, and was the only apology for a window. Occasionally the byre might be seen on one side of the entrance, the family apartment, which served alike for eating and sleeping, on the other. With such limited resources the box beds with shelves within were made a receptacle for all possible odds and ends; while, contrary to all sanitary arrangements, potatoes in heaps were stored beneath. It was quite a rare thing to have a *but* and *ben* for the exclusive use of the household.<sup>5</sup>

Hogg's life at Altrive was very simple. In 1816 he writes to Mr. Blackwood:

You may think me ungrateful for not writing to you as I promised, especially as you have been so mindful of me; but once you see how barren my letter is, you will think different. There is not an article here that can have any interest to a citizen; for though there are a number of blackcocks, muir-fowl, &c., on our hills, there are such a crew of idle fellows (mostly from Edinburgh, I dare say) broke loose on them to-day, that it seems to a peaceful listener at a distance like me as if the French were arrived at the Forest. Yet all this and everything that I have in my power to mention, you know must take place of course. In fact, the people of Edinburgh should always write to their friends in the country, and never expect any answer. For my part, I know that all the letters I ever received from the country while I was there, were most insipid, nor can it otherwise be. We converse only with the elements, and our concerns are of the most trivial and simple nature. For my part, I feel myself so much at home here, and so much in the plain rustic state in which I spent my early years, that I have even forgot to think or muse at all, and my thoughts seem as vacant as the wilderness around me. I even wonder at some of my own past ideas. I have neither written nor corrected a line since I left Edinburgh, and as I never intend returning to it for any length of time, I think I may safely predict without the spirit of prophecy, that you have seen the best and most likely all, of my productions that you will ever see. They have gained me but little fame and far less profit; and certainly the most graceful way of giving up the contest is to retire indignant into my native glens, and consort with the rustic friends of my early youth. This is no *rodomontade*, my dear sir, but the genuine sentiments of my heart at this time. Do not, however, neglect to favor me still with a reading of all new works in my way. I will return the *Melodies*, but I will keep this and the future numbers of the *Review*, and you or Mur-

<sup>5</sup> Russell's *Reminiscences of Yarrow*.

ray may debit me with it as cheap as you like. . . . We have no post nor any carrier from this, and I neither know how nor when I am to get this letter carried.

I take the half of my last sheet of paper to write to you a few lines, and implore you not to insist on my coming to town just yet. Believe me, you do not know what you ask. It is cruel in the extreme. Can I leave my fine house, my gray-hounds, my curling-stones, my silver punch-bowl and mug, my country friends, my sister and my sweetheart, to come and plunge into general dissipation? And, worst of all, can I leave home, a house made by my own hand, and the most snug and comfortable, perhaps, that ever was made, to be a lodger in the house of another, my own ingle-cheek, dish and night-gown, with my parents [waiting] assiduously on me—only to be a pest to others or to pay horribly for lodgings and keep the same establishment at home? I know it is all kindness and affection in you; but they are misdirected, for everyone who wishes me to spend my life happily would wish me to spend it at home. Besides, I cannot take my hand in managing the publication, or pushing the sale of my own works. If delicacy even permitted it, I am the worst hand in the world to do such a thing. Further than the proofs I can do nothing. You are right. The magazine is a most excellent one.

The rains have been prodigious. Ettrick and Yarrow have almost laid their banks waste. I built a small inn on my farm last year, that everybody who was thirsty might get a drink when he liked. About midnight on the 2d, the man who keeps it was alarmed by a rushing sound as of many waters, but as the Yarrow runs at a distance of a quarter of a mile, he laid him down again. In a few minutes after, the waves began to break over the bedclothes in good earnest, on which he sprang up and carried out all his family, one by one, in water to the neck, and they escaped naked and in great dismay to my farmhouse of Mount Benger. No lives were lost but the cat's. She was found drowned on the floor next day.

After five years of residence at Altrive, Hogg was married to Margaret Phillips. As much as ten years before this time, Hogg had met Miss Phillips at the house of his friend Mr. James Gray of Edinburgh, whose first wife was Margaret Phillips' sister. A mutual attachment grew up between the two which, however, did not ripen into love till the more settled circumstances of Hogg's condition that followed his settlement at Altrive. The story of this period of the Shepherd's life has been written for the public only by his daughter in her *Memoir*. The reader is referred to that volume, which is again in print and therefore easily accessible. Much of his correspondence relating to this period is there reproduced. Writes Mrs. Garden:

So, in April, 1820, Hogg went to Dumfrieshire, and in the old mansion house of Mousewaid Place, where Mr. Phillips, having retired from business, was then residing, was married to his Margaret.<sup>6</sup>

Hogg did not find the pathway to marriage altogether smooth. He was now fifty years of age, and the correspondence shows that this fact gave him frequent misgivings. Suspicion and jealousy were rife from time to time, and once almost culminated in a serious quarrel. True love, however, surmounts such trivial rubs, and, once married, Hogg and his wife settled down to the most happy and mutually dependent of lives.

Almost the first occupation of Mrs. Hogg after her removal to Altrive was to nurse her husband; but his illness at this time was amusing rather than serious, for, at the age of fifty, he was taken down with the measles.

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<sup>6</sup> Page 115.

## CHAPTER 6

### THE POETIC MIRROR, ETC.

THE removal from Edinburgh to Altrive necessitated a certain expenditure of money in stocking the farm. Hogg was bankrupt at the time, and he prepared *The Poetic Mirror* in order to make the money needed to stock his new farm. His plan was to issue a volume of poems, each poem written by one of the leading popular poets of the day. Many of them were quick to promise assistance, and Byron originally intended *Lyra* for *The Poetic Mirror*; but few of Hogg's brother bards were as quick to redeem as to give their promises, and Scott absolutely refused to have anything to do with the venture.

This refusal was the cause of their only serious quarrel. Hogg counted upon Scott's contribution as equivalent to the success of the volume. Scott refused to contribute because he considered it unwise and unmanly for Hogg to make money out of other people's work. Hogg's hasty temper, however, caused him to imagine that Scott's refusal was mere discourtesy. He wrote Scott an abusive letter and they were quite estranged for several months. Says Hogg:

I could not even endure to see him at a distance, I felt so degraded by the refusal, and I was at that time more disgusted with all mankind than I have ever been before, or have ever been since.

The result of this quarrel is related below in the words of Mr. Thomson.

It must have been about this time that the Ettrick Shepherd became a member of the Right and Wrong Club. The present was still a transition period of Scottish Society, in which much of the wildness and irregularity of the latter part of the eighteenth century continued to linger; even the embers of the Hellfire Club were not yet wholly extinguished; and *symposia* were frequent among literary characters and men of mark, which only forty years after would have been eschewed by the common people as disreputable. It was not therefore surprising that the social unsuspecting disposition of the Shepherd should involve him in some one of these vortices, and that for a season he should be whirled about in its giddy revolutions. This Right and Wrong Club was established one evening at dinner, and among some choice spirits, tainted with the leaven of the old school, with their entertainer, a young lawyer, afterwards a distinguished barrister, at their head; and their principle of association was, that whatever any of its members should



assert, was to be supported by the whole fraternity, whether *right* or *wrong*. The idea was so delightful, that they met next day at Oman's Hotel, to celebrate the formation of the club; they dined at five o'clock, and separated at two in the morning; and such was the hilarity which had prevailed among these mad revellers, most of them men of scholarship and genius, as well as bacchanals, that they agreed to have a daily meeting of the same kind. It is needless to add that such a paroxysm could not be lasting; and during five or six weeks over which these quotidian meetings extended, some of the members drank themselves into derangement, while others rushed headlong into engagements that ended in marriage. As for Hogg, whose head needed little stimulus beyond the poetry that was in it, he was soon laid up by inflammatory fever, which was not abated by their sympathetic visits, often made at two or three o'clock in the morning, after their meeting dissolved, and when they were in such a hazy or mischievous condition, that they generally broke all the knockers and bell-handles in the stair, amidst their search for the right door. Finding that in spite of their attentions their poet laureate did not recover, the Right and Wrong Club held a consultation upon the subject; and as their deliberation was probably at an early hour of the evening, they wisely resolved to discontinue their meetings until he joined them, and should that never happen, never to meet again. By this resolution, to which they stoutly adhered, the club was broken up. It was probably the last monstrosity of the kind by which the past history of Edinburgh is disfigured.

This severe attack of illness, by which the Shepherd was confined three weeks in bed had almost proved fatal, and was only surmounted by the strength of his constitution and the care of a skilful physician. In the meantime, Sir Walter Scott had heard of his illness; and although all intercourse between them had ceased, he never failed to call every day at *Messers*. Grieve and Scott's to inquire for the patient on his return from his official duties at Parliament House. Nor were these mere calls of ceremony, for one day, taking Mr. Grieve aside, he asked him if Hogg had proper attendance and good medical advice? Mr. Grieve assured him that he had both, and that in the doctor the patient had implicit confidence. "I would fain have called upon him", rejoined Sir Walter, "but I knew not how I would be received. I request, however, that he may have every proper attendance and want for nothing that can contribute to the restoration of his health. And in particular, I have to request that you will let no pecuniary consideration whatever prevent his having the best medical advice in Edinburgh, for I shall see it paid. Poor Hogg! I would not for all that I am worth in the world that anything serious should befall him." Mr. Grieve, as desired kept the secret, so that it was not till some time afterwards that the Shepherd by accident, got information of this interview. He was struck with the kindness of Sir Walter, and afflicted with the thought that he had quarrelled with such a friend, so that he could not rest until he had attempted a reconciliation. The result of this penitent and relenting feeling was the following characteristic letter:—

"To Walter Scott, Esq., Castle Street.

"Gabriel Road, February 28, 1815.

"Mr. Scott,—I think it is great nonsense for two men who are friends at heart, and who ever must be so—indeed it is not in the nature of things that they can be otherwise—should be professed enemies.

"Mr. Grieve and Mr. Laidlaw, who were very severe on me, and to whom I was obliged to show your letter, have long ago convinced me that I mistook part of it, and that it was not me you held in such contempt, but the opinion of the public. The idea that you might mean that (though I still think the reading will bear either construction), has given me much pain; for I knew I answered yours intemperately, and in a mortal rage. I meant to have inclosed yours, and begged of you to return mine, but I cannot find it, and am sure that some one to whom I have been induced to show it has taken it away. However, as my troubles on that subject were never like to wear to an end, I could not longer resist telling you that I am extremely vexed about it. I desire not a renewal of our former intimacy, for haply, after what I have written, your family would not suffer it; but I wish it to be understood that, when we meet *by chance*, we might shake hands, and speak to one another as old acquaintances, and likewise that we may exchange a letter occasionally, for I find there are many things which I yearn to communicate to you, and the tears rush to my eyes when I consider that I may not.

"If you allow of this, pray let me know; and if you do not, let me know. Indeed, I am anxious to hear from you, for 'as the day of trouble is with me, so shall my strength be.' To be friends, *from the teeth forwards* is common enough; but it strikes me that there is something still more ludicrous in the reverse of the picture, and so to be enemies:—and why should I be, *from the teeth forwards*, yours sincerely,

"James Hogg?"

This curious epistle, so indicative of pride struggling with shame in confessing a fault and craving forgiveness, was rightly estimated; and Scott instead of parading a lecture in return, answered by a short note, desiring him to think no more about the matter, and come to breakfast next morning. The pair, so strangely dissimilar, and yet in many points so alike, were united once more, and perhaps their renewed friendship was all the stronger for the interruption. But still, though desired to think no more about it, Hogg could not rest without an explanation of the quarrel, and on the day of that morning, he introduced it, while they walked round St. Andrew Square; but Scott parried the subject. The attempt was renewed by the Shepherd a few days after, in Sir Walter's study; but the latter again eluded it with such dexterity, that Hogg was left in the dark as before, and obliged to conjecture what could be the cause of the other's peremptory refusal of a contribution to *The Poetic Mirror*. This guess, however, did full honor to the character of Scott. "I knew him too well", he says, "to have the least suspicion that there could be any selfish or unfriendly feeling in the determination which he adopted, and I can account for it in no other way.

than by supposing that he thought it mean in me to attempt either to acquire gain, or a name, by the efforts of other men; and that it was much more honorable, to use a proverb of his own, 'that every herring should hang by its own head'.<sup>1</sup>

Meantime our attention has been diverted from the cause of the quarrel. Hogg, in looking over the contributions that had been sent in to form part of *The Thistle and the Rose*, as he first intended to call *The Poetic Mirror*, found that the contributions were not only few in number but poor in quality. His disappointment was great, but short-lived. His mighty self-conceit supplied him with a happy expedient. He determined to take Scott's suggestion and to let this herring hang by its own head. In an incredibly short space of time he himself wrote all but one or two of the poems that compose the volume. This book is certainly one of the most perfect achievements of the kind in the language. The various poems of which it is composed purport to be written by Byron, Scott, Wordsworth, Hogg,<sup>2</sup> Coleridge, Southey, and Wilson. The reader should not be confused because this production is often compared with the *Rejected Addresses*. The two volumes are not to be compared. They are altogether different. The *Rejected Addresses* are parodies; the supposed contributions in *The Poetic Mirror* are forgeries, and, as such, actually imposed upon readers for a brief interval. A few stanzas are sufficient to illustrate the quality of the imitations.

[Scott]

#### WAT O' THE CLEUCH

##### Canto First

Wat o' the Cleuch came down through the dale,  
In helmet and hauberk of glistening mail;  
Full proudly he came on his berry-black steed,  
Caparisoned, belted for warrior deed.  
Oh, bold was the bearing, and brisk the career,  
And broad was the cuirass, and long was the spear,  
And tall was the plume that waved over the brow  
Of that dark reckless borderer, Wat o' the Cleuch.

His housing, the buck's hide, of rude massy fold,  
Was tasselled and tufted with trappings of gold;

<sup>1</sup> Introduction to Hogg's Works, page xxxvi.

<sup>2</sup> *The Gude Grey Katt*, Hogg's imitation of himself, is written in an ancient dialect, difficult to understand. A modernized version of the same, also written by Hogg, is published in Mrs. Garden's *Memoir*.

The henchman was stalworth his buckler that bore;  
He had bowmen behind him and billmen before:  
He had Bellenden, Thorleshope, Reddlefordgreen,  
And Hab o' the Swire, and Jock of Poldean;  
And Whitstone, and Halston, and hard-riding Hugh,  
Were all at the back of bold Wat o' the Cleuch.

As Wat o' the Cleuch came down through the dale,  
The hinds stood aghast and the maidens grew pale;  
The ladies to casement and palisade ran,  
The vassals to loop-hole and low barbican,  
And saw the bold Borderers trooping along,  
Each crooning his war-note or gathering-song:  
Oh, many a rosy cheek changed its hue,  
When sounded the slogan of Wat o' the Cleuch!

And there was kid from Cocket-dale,  
And mutton from the banks of Kaile,  
With head of ox, and ham of steer,  
And rib of roe, and haunch of deer,  
All placed before the mountaineer.

The shades of eve in softest hue  
Began to tint the Cheviot blue;  
But a darker, gloomier veil was wore  
On the swarthy brows of Lammermore;  
While in the vale stood these between  
Dun Ruberslaw and Eildon green,  
One coned with rock, one cleft in three,  
Like ancient dome and monastery  
That for due penance, praise, and shrift,  
Their unassuming heads uplift,  
In midst of mighty city's bound  
With towers and ramparts circled round.

[Wordsworth]

### THE STRANGER

Being a Further Portion of *The Recluse*, a Poem

Fair was the scene and wild—a lonely tarn  
Lay bosomed in the hill; and it was calm  
As face of slumbering childhood—yea, so calm  
That magic mirror of the mountain reign  
Was spread, that vision scarcely could discern  
The water from the land, or rightly mark  
The greensward patch, the hazel bush, the rock,  
From those fair copies on the element,  
The shadow from the substance—save that one  
Was softer and more delicately green.



## THE FLYING TAILOR

Being a Further Extract from *The Recluse*, a Poem

If ever chance or choice thy footsteps lead  
 Into that green and flowery burial-ground  
 That compasseth with sweet and mournful smiles  
 The church of Grasmere, by the eastern gate,  
 Enter, and underneath a stunted yew,  
 Some three yards distant from the gravel-walk,  
 On the left-hand side, thou wilt espy a grave,  
 With unelaborate head-stone beautified,  
 Conspicuous 'mid the other stoneless heaps  
 'Neath which the children of the valley lie.  
 There pause, and with no common feelings read  
 This short inscription—"Here lies buried  
 The Flying Tailor, aged twenty-nine!"

[Coleridge]

## ISABELLE

Can there be a moon in heaven to-night,  
 That the hill and the grey cloud seem so light?  
 The air is whitened by some spell,  
 For there is no moon, I know it well;  
 On this third day the sages say  
 ('Tis wonderful how well they know)  
 The moon is journeying far away,  
 Bright somewhere in a heaven below.

It is a strange and lovely night,  
 A greyish pale, but not white!  
 Is it rain, or is it dew,  
 That falls so thick I see its hue?  
 In rays it follows, one, two, three,  
 Down the air so merrily,  
 Said Isabelle; so let it be!

Why does the Lady Isabelle  
 Sit in the damp and dewy dell,  
 Counting the racks of drizzly rain,  
 And how often the rail cries over again?  
 For she's harping, harping in the brake,  
 Craik, craik—Craik, craik—

The *Poetic Mirror* affords an opportunity to discuss that trait which, tho not of the highest order of artistic merit, was possessed by Hogg to an extent nearly approaching perfection, namely, imitation of literary style. From first to last the Ettrick Shepherd was a mimic. Just as a theatrical mimic often lacks the spark of genius that will make him a creative

actor, so Hogg lacked that genius that would have made him a great creative writer like Scott. His earliest ambition was, not to be a poet, but to be a poet like Burns. It was Scott's open and avowed imitation of the ancient ballads in the third volume of *The Minstrelsy* that led Hogg into a similar attempt, which resulted in *The Mountain Bard*. And, doubtless, it was in imitation of Scott that he produced *The Brownie of Bodsbeck* and *The Siege of Roxburgh*. Tho Hogg occasionally rose above the plane of imitation, it characterizes most of his work, prose as well as verse. It was because he mimiced so well that he deserves so high a place among writers, for he sometimes mimiced the life about him as well as the writings of others. His mimicry of real life is so perfect that it often becomes tedious, lacking, as it does, that art of omission which alone makes realism seem real and is at the same time artistic.

We know so little of just what Hogg read that we cannot say positively that here or there he intended to imitate just this or that. But, knowing his general tendency, one cannot escape the idea that he was familiar with DeFoe. *The Adventures of Captain John Locky* is so exactly like *Captain Singleton* that one could fancy that both sprang from the same brain; yet the fact that it is so far different that DeFoe might have written them both without laying himself open to the charge of repetition is testimony to the capital skill of Hogg's execution.

*Allan Gordon* might have fallen from the pen of DeFoe instead of *Robinson Crusoe*, and still have taken the world by storm. The hero goes north in a whaler which is caught in the ice-floe and lost. He alone escapes to have three years of strange adventures in the northern seas. The ingenuity he displays, the hair-breadth escapes, the touching companionship with a polar bear which he rears from a cub, above all, the naïve simplicity which makes one believe implicitly for the time being that he is reading a simple tale of fact and personal experience is all DeFoe, nothing more, nothing less. We can fancy that Hogg read *Crusoe* and said, "I will do that too", just as he actually said that he would write like Burns, when he first heard *Tam O' Shanter*. And he performed his task so skilfully that he is almost equal to his copy.

It is not the present writer's intention to belittle Hogg's work by harping upon this element of imitation. He firmly believes that Hogg's imitations are far better than Scott's

imitations. Doubtless the latter's failed as imitations just because his greater genius of personality would assert itself. While Hogg, on the other hand, unhampered by any ambition except what was prompted by the wish to do as well as another, succeeded better. In other words, Scott's literary task was on the highest plane and he reached its elevation; Hogg's was on a lower level, which he likewise traversed with unerring footsteps.

I have disclaimed the intention of belittling the literary excellence of the Ettrick Shepherd, and his achievements as an imitator may profitably be contrasted with his success in another field. A contemporary critic of estimation often emphasizes the assertion that a single poetic outburst constitutes a claim to be called a poet. If a single poem like "I wandered lonely as a cloud", is sufficient to establish Wordsworth's reputation as a poet, and who would deny the claim in spite of the fact that he did not always write up to this excellence, then *The Witch of Fife* or *Kilmeny* is sufficient to place Hogg among the elect. But, tho no poet, except, perhaps, Wordsworth, would gain more by selection exercised by a skilful editor, these two poems do not alone constitute Hogg's claim to true poetical creation. In one field he invariably rose above himself and became almost the equal of Burns. In his own day, and in ours, the songs of the Ettrick Shepherd were sung by the firesides of Yarrow. Close examination of his verse fully justifies the verdict of the rustic singers. An enthusiast need fear no contradiction to the assertion that Burns wrote nothing more beautiful than the following:

#### THE SKYLARK

Bird of the wilderness,  
Blithesome and cumberless,  
Sweet be thy matin o'er moorland and lea!  
Emblem of happiness,  
Blest is thy dwelling place—  
Oh, to abide in the desert with thee!

Wild is thy lay and loud,  
Far in the downy cloud,  
Love gives it energy, love gave it birth.  
Where, on thy dewy wing,  
Where art thou journeying?  
Thy lay is in heaven, thy love is on earth.

O'er fell and fountain sheen,  
 O'er moor and mountain green,  
 O'er the red streamer that heralds the day,  
 Over the cloudlet dim,  
 Over the rainbow's rim,  
 Musical cherub, soar, singing, away!

Then, when the gloaming comes,  
 Low in the heather blooms  
 Sweet will thy welcome and bed of love be!  
 Emblem of happiness,  
 Blest is thy dwelling place—  
 Oh, to abide in the desert with thee!

Without any desire to present an anthology of Hogg's songs, a few scattered stanzas are printed in succession to illustrate their diversity, and the music of his rhythm.

#### THE MOON WAS A-WANING

The moon was a-waning,  
 The tempest was over,  
 Fair was the maiden,  
 And fond was the lover;  
 But the snow was so deep  
 That his heart it grew weary,  
 And he sunk down to sleep  
 In the moorland so dreary.

#### BY A BUSH

By a bush on yonder brae,  
 Where the airy Bengier rises,  
 Sandy tun'd his artless lay;  
 Thus he sung the lea-lang day,  
 "Thou shalt ever be my theme,  
 Yarrow, winding down the hollow,  
 With thy bonny sister stream,  
 Sweeping through the broom so yellow.  
 On these banks thy waters lave,  
 Oft the warrior found a grave.

#### O, JEANIE, THERE'S NAETHING TO FEAR

Oh, my lassie, our joy to complete again,  
 Meet me again i' the gloaming, my dearie;  
 Low down in the dell let us meet again—  
 Oh, Jeanie, there's naething to fear ye!  
 Come, when the wee bat flits silent and eiry,  
 Come, when the pale face o' Nature looks weary;  
 Love be thy sure defense,  
 Beauty and innocence—  
 Oh, Jeanie, there's naething to fear ye!



## WHEN THE KYE COMES HAME

Then since all nature joins  
 In this love without alloy,  
 Oh, wha wad prove a traitor  
 To Nature's dearest joy?  
 Oh wha wad choose a crown,  
 Wi' its perils and its fame,  
 And *miss* his bonnie lassie  
 When the kye comes hame,  
 When the kye comes hame,  
 When the kye comes hame,  
 'Tween the gloaming and the mirk,  
 When the kye comes hame!

## A BOY'S SONG

Where the pools are bright and deep,  
 Where the grey trout lies asleep,  
 Up the river and o'er the lea,  
 That's the way for Billy and me.

## FAREWELL TO GLEN-SHALLOCH

Farewell to Glen-Shalloch,  
 A farewell forever;  
 Farewell to my wee cot  
 That stands by the river!  
 The fall is loud sounding  
 In voices that vary,  
 And the echoes surrounding  
 Lament with my Mary.

I saw her last night,  
 'Mid the rocks that enclose them,  
 With a child at her knee  
 And a child at her bosom:  
 I heard her sweet voice  
 'Mid the depth of my slumber,  
 And the song that she sung  
 Was of sorrow and cumber.

"Sleep sound, my sweet babe!  
 There is nought to alarm thee;  
 The sons of the valley  
 No power have to harm thee.  
 I'll sing thee to rest  
 In the balloch untrodden,  
 With a coronach sad  
 For the slain of Culloden."

## DONALD M'DONALD

My name it is Donald M'Donald,  
 I live in the Hielands sae grand;  
 I hae follow'd our banner, and will do,  
 Wherever my Maker has land.  
 When rankit amang the blue bonnets,  
 Nae danger can fear me ava;  
 I ken that my brethren around me  
 Are either to conquer or fa'.  
     Brogues an' brochen an' a',  
     Brochen an' brogues an' a';  
     An' is nae her very weel aff,  
     Wi' her brogues an' brochen an' a'?

## MOGGY AND ME

Oh wha are sae happy as me an' my Moggy?  
 Oh wha are sae happy as Moggy an' me?  
 We're baith turnin' auld, an' our walth is soon tauld,  
 But contentment bides aye in our cottage sae wee.  
 She toils a' the day when I'm out wi' the hirsle,  
 An' chants to the bairns while I sing on the brae;  
 An' aye her blithe smile welcomes me frae my toil,  
 When down the glen I come weary an' wae.

## POOR LITTLE JESSIE

Oh, what gart me greet when I parted wi' Willie,  
 While at his guid fortune ilk ane was so fain?  
 The neighbors upbraidit an' said it was silly,  
 When I was sae soon to see Willie again.  
 He gae me his hand as we gaed to the river,  
 For oh, he was aye a kind brother to me;  
 Right sair was my heart from my Willie to sever,  
 And saut was the dew-drop that smartit my e'e.

## CAMERON'S WELCOME HAME

Oh strike your harp, my Mary,  
 Its loudest, liveliest key,  
 An' join the sounding correi  
 In its wild melody;  
 For burn, an' breeze, an' billow,  
 Their sangs are a' the same,  
 And every waving willow  
 Soughs "Cameron's welcome hame."

## MORNING

Human life is but a day;  
 Gay its morn, but short as gay;  
 Day of evil—day of sorrow!  
 Hope—even hope can paint no morrow.  
 Steeped in sloth or passions boiling,  
 Noon shall find thee faint and toiling:  
 Evening rears her mantle dreary;  
 Evening finds thee pale and weary.  
 Prospects blasted—aims misguided—  
 For the future ill provided—  
 Murmuring, worn, enfeebled, shaking—  
 Days of sorrow, nights of waking—  
 Yield thy soul unto the Giver;  
 Bow thy head, and sleep forever!  
 Rise, O rise, to work betake thee!  
 Wake thee, drowsy slumberer, wake thee!

What remains to be said of Hogg's verse may as well be said here. In 1817 he produced *Dramatic Tales*, in two volumes.<sup>3</sup> He was, however, quite ignorant of the practical details of the playwright's art, and, of course, could not produce an actable drama. In attempting this form of composition he bade good-bye to his poetical talents. The result is that his *Dramatic Tales* contain nothing over which it is worth while to pause.

In 1822 his poems were issued in four volumes, and in the same year, *The Royal Jubilee*, a masque commemorative of the coronation of George IV.<sup>4</sup> This masque, tho interesting in parts, is generally monotonous, and flattens out completely at the end. The best verses are the songs, one of which is as follows:

The day is past;  
 It was the last  
 Of suffering and of sorrow:  
 And o'er the men  
 Of northern glen  
 Arose a brighter morrow:

<sup>3</sup> Contents: *All-hallow Eve*, *Sir Anthony Moore*, *The Profligate Princess*, *The Haunted Glen*.

<sup>4</sup> Scott, at the cost of a good deal of trouble, procured Hogg an invitation to be present at the coronation. It afforded Scott the theme for one of his amusing stories to the effect that Hogg refused the invitation rather than forego the pleasures of St. Boswell's Fair. In fact, however, Hogg, who had made so many agricultural failures, would not risk the profits of a year by absenting himself from the principal annual market day.

The pibroch rang  
With border clang  
Along the hills of heather;  
And fresh and strong  
The thistle sprung  
That had begun to wither.

With the exception of a few songs and short poems, Hogg produced no more verse of consequence subsequent to the publication of *The Queen's Wake*. Volume I of *The Jacobite Relics* appeared in 1819 and Volume II in 1821. The collection is valuable only so far as it preserves the text of political songs that would otherwise have been lost. The voluminous notes by Hogg are oftentimes historically inaccurate, and are of no literary value. *Queen Hynde*, his longest composition in verse, is the most formless and monotonous. Hogg never possessed the ability to exercise sustained effort in verse. *The Queen's Wake* is, in reality, but a succession of short poems written at various times and loosely strung together. His three other long poems, *The Pilgrims of the Sun*, *Mador of the Moor*, and *Queen Hynde*, all show decided lack of inspiration, and have fallen into deserved obscurity. *Songs*, 1831, and *A Queer Book*, 1832, complete the list of volumes of verse published during the Shepherd's lifetime. They are both merely collections of poems that had been already published.

*The Poetic Mirror* was published in 1816, and in 1818 appeared the first of Hogg's important compositions in prose. In spite of the subsequent volumes of verse, Hogg may be considered from this date as a prose writer, an aspect that will be examined in a subsequent chapter.



## CHAPTER 7

### RELATIONS WITH BLACKWOOD

THO Hogg's relations with Mr. Blackwood extended over many years, it is thought advisable to give the narrative in connected form in one place. It has already been said that Hogg's acquaintance with his future publisher began when he met the latter in the capacity of one of Goldie's executors. Hogg writes as follows in the *Autobiography*:

From the time I gave up *The Spy* I had been planning with my friends to commence the publication of a magazine on a new plan, but for several years we only conversed about the utility of such a work without doing anything farther. At length, among others, I chanced to mention it to Mr. Thomas Pringle, when I found that he and his friends had a plan in contemplation of the same kind. We agreed to join our efforts and try to set it agoing; but, as I declined the editorship on account of residing mostly on my farm at a distance from town, it became a puzzling question who was the best qualified among our friends for that undertaking. We at length fixed on Mr. Gray as the fittest person for the principal department, and I mentioned the plan to Mr. Blackwood, who, to my astonishment, I found had likewise long been cherishing a plan of the same kind. He said he knew nothing about Pringle, and always had his eye on me as a principal assistant, but he would not begin the undertaking until he saw he could do it with effect. Finding him, however, disposed to encourage such a work, Pringle, at my suggestion, made out a plan in writing, with a list of his supporters, and sent it in a letter to me. I enclosed it in another and sent it to Mr. Blackwood, and not long after that period Pringle and he came to an arrangement about commencing the work while I was in the country. Thus I had the honour of being the beginner, and almost sole instigator of that celebrated work, *Blackwood's Magazine*; but from the time I heard that Pringle had taken in Cleghorn as a partner I declined all connection with it, farther than as an occasional contributor. I told him the connection would not likely last for a year, and insisted that he should break it at once, but to this proposal he would in nowise listen. As I had predicted, so it fell out, and much sooner than might have been expected. In the fourth month after the commencement of that work, I received a letter from Mr. Blackwood, soliciting my return to Edinburgh, and when I arrived there I found that he and his two redoubted editors had gone to loggerheads, and instead of arguing the matter face to face they were corresponding together at the rate of about a sheet an hour. Viewing this as a ridiculous mode of proceeding, I brought about two meetings between Mr. Blackwood and Mr. Pringle, and endeavored all that I could to bring them to a right understanding about the matter. A reconciliation was effected at that time and I returned again to the country. Soon, however, I heard that the flames of controversy, and proud opposition, had broken out between the

parties with greater fury than ever, and shortly after, that they had finally separated and the two champions gone over and enlisted under the banners of Mr. Constable, having left Mr. Blackwood to shift for himself, and carried over, as they pretended, their right to the magazine, with all their subscribers and contributors to the other side.

The account of the origin of Mr. Blackwood's publication as given above is true enough in the main, tho Hogg vastly magnifies the importance of the part played by himself. Doubtless some such idea did occur to him even some time before he made it public; and, when upon discovery he found that Blackwood already had the plan afoot, and Hogg was taken in as a principal contributor, it is easy to see how in later years he might have written this account in perfect good faith.

A letter from Hogg to Blackwood, dated Altrive Lake, August 12, 1817, more truly sets forth their literary relations at that time.

My hay harvest is but just commenced, and is this year large in proportion to the hands I have to work it. Next month the Highland cattle come, so that I cannot get to Edinburgh at present without incurring a loss, for which my literary labors, if they are as usual, would but ill remunerate me. I am greatly concerned about your magazine, but I have some dependence on your spirit not to let it drop or relax till your literary friends gather again about you. Wilson's papers, though not perfect, have a masterly cast about them. A little custom would make him the best periodical writer of the age—keep hold of him. I regret much that you have told me so little of your plan. If the name is to change, who is to be the editor, &c? For myself, I am doing nothing save working at hay, fishing, &c. Save two or three Hebrew melodies, I have not written a line since I left Edinburgh. I cannot leave the country just now. Crafty [Constable] always affirms that of all classes ever he had to do with the literary men are the worst and most ungrateful. I am very sorry to see this so often verified.

So much applies to the periodical that ran for six months before the publication known as *Blackwood's Edinburgh Magazine* was finally started in its permanent form as a result of the thoro reorganization of the editorial staff. One of the first numbers contained an article that set all Edinburgh by the ears and well-nigh ruined the undertaking. This was the famous *Chaldee MS.* Tho this composition is not a part of the *Noctes Ambrosianae*, it is printed in Ferrier's edition of that work with full explanatory notes, to which the inquisitive reader is referred. In the preface Mr. Ferrier says that

he will clear up a bit of literary history that has hitherto been obscure; by which he means that he will indicate what parts of the *Chaldee MS* were written by Hogg.

One who is interested in the Ettrick Shepherd is more concerned with his relation to the paper than with the question as to what parts written by his hand actually remained in the finished draft as it was published. This composition was divided into chapter and verse, and written thruout in Biblical style. Hogg, as we have seen from *The Poetic Mirror*, was a master of literary forgery, and his imitation of the Bible was so accurate and spent upon such an unworthy quarrel that most people were out and out offended at it as a piece of sacrilege. But this profanity was not its only offense. In form it was like the Bible; in substance, a biting satire directed against all the Edinburgh writers and publishers who were in any way opposed to Mr. Blackwood and his friends.

Doubtless Hogg conceived the notion and wrote the first draft. He certainly did not know how good it was and neither expected it to receive such favor from Blackwood and his set, or such disfavor from the public. Before it appeared in print it was revised and enlarged to such an extent that the portions indicated by Mr. Ferrier as having been written by Hogg are by no means the greater part of the composition. *The Chaldee MS.* created such a storm, and to live it down required such a struggle on the part of Blackwood and his men, that they, including Hogg, were bound all the closer by the ties of adversity. (The article was withdrawn from subsequent issues and apologized for by the editors. It is now very rare except in reprints.)<sup>1</sup>

Between 1822 and 1835 a series of articles, the *Noctes Ambrosianae* (not all, however, by Wilson), was contributed to *Blackwood's Magazine*. They are too well known to need description. It is only fair to say that the most brilliant creation in this group of brilliants, who goes by the name of

<sup>1</sup> It is interesting to note the following paragraph that is in the 1832 edition of the *Autobiography*, but which is omitted from subsequent editions:

"So little had I intended giving offence by what appeared in the magazine, that I had written out a long continuation, of the manuscript, which I have by me till this day, in which I go over the painters, poets, lawyers, booksellers, magistrates, and ministers of Edinburgh, all in the same style; and with reference to the first part that was published, I might say of the latter as King Rehoboam said to the Elders of Israel, 'My little finger was thicker than my father's loins.' It took all the energy of Mr. Wilson and his friends, and some sharp remembrances from Sir Walter Scott, as well as a great deal of controversy and battling with Mr. Grieve, to prevent me from publishing the whole work as a large pamphlet, and putting my name to it."



the Ettrick Shepherd, is a burlesque of Hogg, not the man himself.

Hogg's treatment of this use of his name was curious. At times he took it as a good joke, at times it annoyed him immensely. The popularity it gave him and the flattery it contained ministered to his sense of vanity. Certain it is that he allowed the articles to appear month after month and made no protest. Yet Hogg was no drunkard and one can easily justify his anger over some of the debauches in which he is made to figure. March 28, 1828, Hogg writes to Blackwood as follows:

I am exceedingly disgusted with the last beastly *Noctes*, and as it is manifest that the old business of mocking and ridicule is again beginning, I have been earnestly advised by several of my best and dearest friends to let you hear from me in a way to which I have a great aversion. But if I do, believe me, it shall be free of all malice, and merely to clear my character of sentiments and actions which I detest, and which have proved highly detrimental to me.

Scott was evidently not one of the friends who advised Hogg to adopt a rash behaviour, as the following letter shows:

My dear Hogg:—I am very sorry to observe from the tenor of your letter that you have permitted the caricature in *Blackwood's Magazine* to sit so near your feelings, though I am not surprised that it should have given pain to Mrs. Hogg. Amends, or if you please revenge, is a natural wish of human nature when it receives these sorts of provocation, but in general it cannot be gratified without entailing much worse consequences than could possibly flow from the first injury. No human being who has common sense can possibly think otherwise of you than he did before—, after reading all the tirades of extravagant ridicule with which the article is filled. It is plain to me that the writer of the article neither thought of you as he has expressed himself, nor expected or desired the reader to do so. He only wished to give you momentary pain, and were I you I would not let him see that in this he has succeeded. To answer such an article seriously would be fighting with a shadow and throwing stones at moonshine. If a man says that I am guilty of some particular fact, I would vindicate myself if I could; but if he caricatures my person and depreciates my talents, I would content myself with thinking that the world will judge of my exterior and of my powers of composition by the evidence of their own eyes and of my works. I cannot as a lawyer and a friend advise you to go to law. A defense would be certainly set up upon the *Chaldee MS.*, and upon many passages in your own account of your own life, and your complaint of personality would be met with the proverb that "He who plays at bowls must meet with rubbers." As to knocking out of brains, that is talking *no how*; if you would knock any brains into a bookseller you would have my consent, but not to knock out any part of the portion with which heaven has endowed them.



I know the advice to be quiet under injury is hard to flesh and blood. But nevertheless, I give it under the firmest conviction that it is the best for your peace, happiness and credit. The public has shown their full sense of your original genius, and I think this unjust aggression and extravagant affectation of depreciating you will make no impression on their feelings. I would also distrust the opinions of those friends who urge you to hostilities. They may be over-zealous in your behalf and overlook the preservation of your ease and your comforts, like the brewer's man who pushed his guest into the boiling vat that he might be sure to give him drink enough, or they may be a little malicious and have no objection (either from personal motives or for the mere fun's sake) to egg on and encourage a quarrel. In all the literary quarrels of my time, and I have seen many, I remember none in which both parties did not come off with injured peace of mind and diminished reputation. It is as if a decent man was seen boxing in the street.

It is therefore my earnest advice to you to look on the whole matter with contempt, and never in one way or other take any notice of it. (Goldie's publication might with some people have a bad effect, because he certainly had reason to complain.) But this absurd piece of extravagance can have none—it leaves you, in every respect, the same James Hogg it found you, or if otherwise, it arms in your favor those generous feelings which revolt at seeing your parts and talents made the subject of ill-natured ridicule.

I am sure I feel for Mrs. Hogg on the occasion, because as an affectionate wife, I am sure she must feel hurt and angry on your behalf. But then she must as a woman of sense reconcile herself to the course most favorable to your peace of mind, your private fortunes and the safety of your person. . . . But if you come here agreeable to what is requested in the enclosed we will be most heartily glad to see you, and will consider what can be done in that part of the matter.

I have only to add that I myself, in similar circumstances, should take no notice of any piece of scurrilous railery which appeared anonymously in periodical publications, and that I should conceive my honor much more hurt in descending to such a contest than in neglecting or condemning the injury. Yours very truly,

Abbotsford, Saturday.

W. SCOTT.

Hogg was of a very forgivable disposition and his anger soon passed away. Says Mrs. Garden:

Among others, Mrs. Hogg felt deeply hurt at these representations, and, although her husband used to peruse them with merry laughter as each new number of *Maga* made its appearance, her heart used to quicken its beat and her gentle spirit was wounded, because her kind husband was, to her thinking, turned into heartless ridicule in these horrid *Noctes*. Occasionally and wisely she refused to read them.

For some years Hogg continued to contribute regularly to *Blackwood's Magazine*, and remained upon terms of friend-

ship with the editor, saving, perhaps, now and then a trivial exchange of temper. In 1832, however, they had a serious quarrel. In this year Hogg published his *Autobiography* again as introduction to *The Altrive Tales*. It contained the following passage which has been omitted from subsequent editions:

In the spring of 1829 I first mentioned the plan of *The Altrive Tales* to Mr. Blackwood in a letter. He said in answer that the publication of them would be playing a sure card if Mr. Lockhart would edit them. He and I waited on Mr. Lockhart subsequently at Chiefswood and proposed the plan to him. He said that he would cheerfully assist me both in the selection and the correction, but that it was altogether without a precedent for one author to publish an edition of the works of another while the latter was still alive, and better qualified than *any* other person to supervise the work. Blackwood then requested me to begin writing and arranging forthwith that we might begin publishing about the end of the year. But when the end of the year came he put me off until the next spring, and then desired me to continue my labors till November next, as I should still be making the work better, and would ultimately profit by so doing. Then when last November came he answered a letter of mine in very bad humor, stating that he would neither advance me money on the work that had laid a year unpublished, nor commence a new work in a time of such agitation, and that I *must not* think of it for another year at least.

I then began to suspect that the whole pretense had all along been only a blind to keep me from London, whither I had proposed going, and keep me entirely in his own power. So rather than offer the series to any other Scottish bookseller, I carried it at once to London, where it was cordially accepted on my own terms without the intervention or the assistance of anybody. It was not without the greatest reluctance that I left my family in the wilderness, but I had no alternative. It behoved me either to remain there and starve or try my success in the metropolis of the empire, where I could have the assistance of more than one friend on whose good taste and critical discernment I could implicitly rely.

The *Autobiography* also contains the following note concerning Blackwood's dealing:

I confess that there was a good deal of wrangling between Mr. Blackwood and me with regard to a hundred-pound bill of Messrs. Longman & Co.'s advanced on the credit of these works. When Mr. Blackwood came to be a sharer in them, and to find that he was likely to be a loser of that sum, or a great part of it, he caused me to make over a bill to him of the same amount, which he afterwards charged me with, and deducted from our subsequent transactions:—so that, as far as ever I could be made to understand the matter, after many letters and arguments, I never received into my own hand one penny for these two works. I do not accuse Mr. Blackwood of dishonesty; on the contrary, with all his faults,

I never saw anything but honor and integrity about him. But this was the fact. Messrs. Longman & Co. advanced me one hundred pounds on the credit of one or both of the works: I drew the money for the note, or rather I believe Mr. Blackwood drew it out of the bank for me. But he compelled me, whether I would or not, to grant him my promissory note for the same sum, and I was to have a moiety of the proceeds from both houses. The account was carried on against me till finally obliterated; but the proceeds I never heard of, and yet, on coming to London, I find that Messrs. Longman & Co. have not a copy of either of the works, nor have had any for a number of years. It is probable that they may have sold them off at a trade sale, and at a very cheap rate, too; but half of the edition was mine and they ought to have consulted me, or at least informed me of the transaction. It was because I had an implicit confidence in Blackwood's honor that I signed the bill, though I told him I could not comprehend it. The whole of that trifling business has to this day continued a complete mystery to me. I have told the plain truth, and if any of the parties can explain it away I shall be obliged to them. If the money should ever by any chance drop in, "better late than never" will be my salutation.

These and other expressions of like intent enraged Blackwood, and a serious quarrel followed. Its results can best be told by a few extracts from the correspondence of Christopher North.

Wilson writes offering to mediate between Hogg and Blackwood; after suggesting that all past differences be forgotten he continues:

But you have accused Mr. Blackwood in your correspondence with him, as I understand, of shabbiness, meanness, selfish motives, and almost dishonesty. In your memoir there is an allusion to some transaction about a bill which directly charges Mr. Blackwood with want of integrity. In that light it was received by a knave and fool in *Fraser's Magazine*, and on it was founded a charge of downright dishonesty against a perfectly honest and upright man. Now, my good sir, insinuation and accusation of this kind are quite another guess sort of matter from mere ebullitions of temper, and it is impossible that Mr. Blackwood can ever make up any quarrel with any man *who doubts his integrity*. It is your bounden duty to make amends to him on this subject. But even here I would not counsel *any apology*. I would say that it is your duty as an honest man to say fully and freely, and unequivocally, that you know Mr. Blackwood to be one, and in all his dealings with you has behaved as one.

Wilson goes on to say that Hogg shall not again be written up in the *Noctes* if Hogg objects. The next letter hints at what was Hogg's reply to the offer of mediation.

On considering its various contents, I feel that I can be of no use at the present in effecting a reconciliation between you and Mr. Blackwood.



If you never made any accusation of the kind I mentioned against Mr. Blackwood, then am I ignorant of the merits of the case altogether, and my interference is only an additional instance of the danger of voluntary counsel, with erroneous impressions of the relative situations of the parties. I proposed a plan of reconciliation, which seemed to me to make no unpleasant demand on either party, and which was extremely simple; but it would seem that I took for granted certain accusations or insinuations against Mr. Blackwood's character as a man of business that you never made.

The following extracts are from a letter to Mr. Grieve:

If Mr. Hogg puts his return as a writer to *Maga* on the ground that *Maga* suffers greatly from his absence from her pages, and that Mr. B. must be very desirous of his assistance, that will at once be a stumbling block in the way of settlement; for Mr. B., whether rightly or wrongly, will not make the admission. . . .

I wrote the *Noctes* to benefit and do honor to Mr. Hogg, much more than to benefit myself, and but for them he, with all his extraordinary powers, would not have been universally known as he now is; for poetical fame, as you well know, is fleeting and precarious. After more than a dozen years' acquaintance and delight in the *Noctes* the Shepherd, because he quarreled with Mr. Blackwood *on other grounds*, puts an end to them, which, by the by, he had no *right* to do. . . .

There are various other points to be attended to. The magazine *now* is the least *personal* periodical existing, and it will continue so. Now Mr. Hogg may wish to insert articles about London and so on that may be *extremely personal*. Mr. Blackwood could not take such articles. He *has himself* reason to be offended with Mr. Hogg's writing about himself, and could not consistently in like manner offend others. . . .

With respect to past quarrels, they should be at once forgotten by both parties and not a word said about them, except *if* Mr. Hogg has published anything reflecting on Mr. Blackwood's *integrity*. *I think he has*. That, therefore, must be done away with by the Shepherd in the magazine itself, but not in the way of *apology*, but in a manly manner, such as would do honor to himself and at once put down all the calumnies of others to which Mr. Blackwood has been unjustly exposed, especially in *Fraser's Magazine*. All abuse of Mr. Blackwood in that work, *as founded on his behavior to Mr. Hogg*, must, by Mr. Hogg, be put a stop to; for if he continues to write in *Fraser* and to allow those people to put into his mouth whatever they choose (and they hold him up to ridicule every month after a different manner from the *Noctes*!), their abuse of Mr. Blackwood will seem to be sanctioned by Mr. Hogg, and neutralize whatever he may say in *Maga*.

Mrs. Garden adds:

The result of these friendly negotiations may be gathered from the *Noctes* of May, 1834, in which there is a lively and most amusing description of the Shepherd's return to the bosom of his friends in the tent at the Fairy's Cleugh.



After so much has been said concerning this quarrel with the man who, next to Scott, was Hogg's best friend, it is interesting to note what the Shepherd wrote later, in the year of Mr. Blackwood's death.

I will be very sorry to object to any arrangement that so kind a friend has made manifestly for my benefit. It was what I wished and proposed last year, that all bygones should be bygones, and never once more mentioned. It is by far the best way of settling a difference when so many alternate kindnesses have passed between the parties. For, though Mr. Blackwood often hurt my literary pride, I have always confessed, and will confess to my dying day, that I knew no man who wished me better, or was more interested in my success.

## CHAPTER 8

### HOGG AS A PROSE WRITER

Tho Hogg is more notable as a prose writer than as a poet, his tales are not without many faults. In practice he did not always live up to the excellent description of what a short story should be, which opens *Gordon the Gypsy*. Hogg says:

It has been tritely, because truly said, that the boldest efforts of human imagination cannot exceed the romance of real life. The best written tale is not that which most resembles the ordinary chain of events and characters, but that which, by selecting and combining them, conceals those inconsistencies and deficiencies that leave, in real life, our sense of sight unsatisfied. An author delights his reader when he exhibits incidents distinctly and naturally according with moral justice; his portraits delight us when they resemble our fellow creatures, without too accurately tracing their moles and blemishes. This elegant delight is the breathing of a purer spirit within us that asserts its claim to a nobler and more perfect state; yet another, though an austerer kind of pleasure, arises when we consider how much of the divinity appears even in man's most erring state, and how much of "goodliness in evil."

Hogg's tales, with one or two exceptions, are all of a kind. He was essentially a short-story writer. He is at his best in stories that are short, and his long compositions are often but a succession of incidents loosely strung together. In fact, *The Adventures of George Cochrane* originally appeared as a series of separate adventures in *The Spy*.

In his volumes of short stories appear many purely descriptive sketches which, however, are usually written in the narrative form. Description of a special kind was Hogg's particular forte; namely, the wild, rugged scenery of his native land, and the fierce commotion of the elements. The paper on *Storms*, now usually included in *The Shepherd's Calendar*, is a most splendid piece of writing.

However, Hogg's special contribution to Scottish literature is relative to the history of folklore tradition. He knew the tales of the Forest as Dickens knew the streets of London. Customs, beliefs, happenings, have been rescued from forgotten obscurity and reproduced in Hogg's writings by the multitude. Of fairies, he knew all, and his knowledge of ghosts was unlimited.

Hogg's manner of dealing with such matters was naïve. It must be borne in mind that the Ettrick Forest eighty years ago

was still isolated from the rest of the world. In that neighborhood lingered longest the oral tradition of the old balladry, and, like the ancient nation of Strathclyde, superstition found its last stronghold in the mountain fastnesses of Selkirkshire, ghost-haunted by the persecuted Covenanters. Hogg himself was a firm believer in many of the supernatural tales he wrote. It is due to this fact that they have such a convincing air of truth about them; and it was also due to this fact that it never occurred to Hogg that a rational explanation was needed. He told a ghost story just as he described a storm: the way it happened. The highest tribute to the excellence of his productions is that one cannot find it in one's heart to contradict the assumption.

One of the most characteristic of Hogg's short stories, which, tho not dealing with the supernatural, illustrates his method of telling either kind, is *The Long Pack*.

One afternoon a peddler, carrying on his back a pack, very large and very long, arrives at a farmhouse where no one is at home except a maid-servant. He insists upon staying all night as he is too tired to go on with his heavy pack. Thoroly frightened and dismayed, the maid tries every way to get rid of him, but without success. At last, however, the peddler agrees to seek lodgings elsewhere if she will allow him to leave the pack in the house over night. Later in the evening the domestic thinks that she sees the pack move. In terror she rouses one of the hinds who sleeps in an adjoining outhouse. He makes fun of her fears and, in order to convince her of her foolishness, discharges a musket at the pack. There is a shriek of pain, and the pack doubles up and tumbles on the floor. Then all is quiet. Upon examination the pack is found to contain a man who has just been shot dead. Later in the night an attack is made on the house by a large body of armed horsemen who are driven away by several persons who have been hastily summoned into the house for protection. In the morning it is found that some of the attacking party had returned to the scene of their defeat and had removed all outward signs of the fray.

This story is told so vividly that the reader is kept gasping to the end. So much the greater is his disappointment to find that there is no end. There was never any clue in fact as to who the man in the pack was—there is none in the story; there was, in fact, never any clue as to who the horse-

men were or what they wanted—nor is there any in the story. At the end one is sure that he has been reading an unmutated transcript of fact, one of the events in life that happen but are never explained.

This story illustrates Hogg's method of telling whatever comes up. Whether it is the supernatural or real life with which he is dealing, he tells what occurred and never bothers himself with explanations. It must not be thought that he used this method to cover up careless plotting, or that he fell back upon the *deus ex machina* resolutions that disfigure the pages of Miss Edgeworth. Hogg's imagination was so vivid and so concrete, so accurate and so detailed, that he never introduces one of these unexplained climaxes accompanied by the least impression upon the reader's mind of unreality.

The way he manages to convey this impression of truth is very simple. His stories contain many phrases of this kind: "This is a true story", "An old woman of above ninety who had seen it with her own eyes", "The following is set forth as a fact, as I discovered in an old MS.", etc., etc. These phrases, however, are but the ear-marks of truth and are so artificial as often to be futile. Hogg really convinces his reader of the truth of the story by the multitude of artfully inserted details. No worm mark upon a fence-post is too small for his notice. Whenever there is occasion to doubt, Hogg floods the reader with a wave of proof. One cannot doubt in the face of so much evidence. And it would be an impossibility now to tell which of Hogg's tales are true and which are not.

The setting of most of Hogg's stories is his native forest, the loved Highlands, and Edinburgh, tho in some of his verse he wanders into imaginary scenes of imaginary lands. History as a background figures in only a few of them. His most successful historical attempt is *The Brownie of Bodsbeck* where Claverhouse's cruelty in the vale of Yarrow is made the theme. In *The Siege of Roxburgh* he is less successful, and in such stories as *The Bridal of Polmood* the historical characters are little more than names.

As a creator of original characters, Hogg can lay only doubtful claim. One of his novels, *The Three Perils of Woman*, has not been included in any of his collected works, but contains, in Cherry, the one character of Hogg's that bears the stamp of splendid creative imagination. His next



most brilliant success is the Fanatic, who, however, is rather a man insane than a human being. Hogg did, however, excel in the short character sketch. His bold outline pictures of from a single paragraph to a few pages cannot be excelled. In a few significant sentences he places before one the outline of a person, so vivid and individual, that he could be recognized in a crowd. Hogg's failure lies in the fact that, in general, his characters remain sketches to the end. They do not grow. He goes over and over the same outline; and at the end of the tale one knows the dramatis personae little better than he did at the end of the first chapter.

A few words may be said concerning the more notable of Hogg's works. Just why *The Brownie of Bodsbeck* should challenge comparison with *Old Mortality* is not apparent to the present writer. They are both tales of Covenanter persecution, and Claverhouse appears in each. Beyond this, however, there is no resemblance; in fact, in every other respect the two books are different. Soon after the *Brownie* was written Hogg called upon Scott; and the Shepherd relates in his *Autobiography* how he found Scott with lowering brow and in an ill-temper about the book. Several writers have attributed Scott's ill-temper to the fact that Hogg had encroached too closely upon his, Scott's, especial field of historical fiction. Such a notion, however, is wholly erroneous. Scott was a royalist in all his feelings and he drew the great Graham as a stern and relentless warrior but as a thoro gentleman. Hogg, on the other hand, portrays Clavers (he never uses a more respectful term) as a despicable brute, utterly without any trace of justice or humanity. It was for this view of the man's character that Scott's brow lowered and that he took the Shepherd to task.

The differences between the books are manifold. *The Brownie* is short in comparison with *Old Mortality*. It is not a tale, rounded out with many interests, various groups of characters, and an entertaining love story such as is found in *Old Mortality*. *The Brownie* is more like a modern short story, dealing with one group of peasant people, and almost with a single situation. Claverhouse alone is drawn from a different life and personally he is one of the minor characters. The story deals with the effects of his one brutal appearance.

This has been called the best story written about the Covenanters, and is certainly the best known of Hogg's stories.

It is also, perhaps, the most original, for, thruout all Hogg's mimicry there is the desire to vary enough not to lay himself open to the charge of forgery, except in *The Poetic Mirror*; and it is when such a desire finds full play that Hogg rises above the merit of a mere imitator in prose.

The characters are extremely well drawn. Walter Laidlaw, a farmer at Chapelhope, is bulky, simple-hearted, generous, and well knows his own good qualities, yet is free of vain conceit. Maron Linton is a simpering fool, nose-led by a profligate priest. Katharine, the sound-hearted, generous daughter, is less satisfactory, and only just escapes the charge of being colorless and insipid. Roy McPherson, with his peculiar dialect, his love of genealogy, and pride in Laidlaw who must be the chief of a clan because he, McPherson, knows no other man of the same name, is a creation that Scott himself need not have blushed for. The other characters are mere sketches, but they are drawn in bold outline and with striking vigor. The eccentric old domestic Nanny was said by Scott to be the best character Hogg ever painted, an observation that was certainly true at the time the book was written.

Few persons would lay the volume down without reading it to the end. Yet a second reading at once reveals the characteristic faults that the Shepherd never overcame. Sir Walter often accused Hogg of not taking pains enough; but the error was irremediable. Hogg wrote a tale just as he heard it or imagined that he had heard it and, tho the present story is open to objections, one is compelled to confess that it is true. One cannot understand how it is that, while Walter and his daughter are for a long time engaged in shielding two separate bands of Covenanters, both hiding in the same hills, each patron stealing from the same larder—why it is that they never stumbled on the same path or suspected the inclination of each other's minds. Hogg might well say, "Such was the tale as it was told to me", and the manner of telling forces the reader to acknowledge, "that there must be some explanation for it so happened".

*The Siege of Roxburgh* was originally published under the name of *The Three Perils of Man*. This volume was the next long tale to follow *The Brownie of Bodsbeck*, to which it was in many respects inferior. With two exceptions (*The Confessions of a Fanatic* and *The Three Perils of Woman*) Hogg was, as has been said, essentially a short story writer. His

longer compositions, in the main, are but collections of episodes strung together on some loosely woven tangle of narrative, a method that is well illustrated by the structure of *The Queen's Wake*. *The Siege of Roxburgh* consists of but one situation. An English lady commands her lover to capture the castle and hold it till Christmas day to prove his love. The Scottish Princess bids Douglas recapture it—her hand is to be his reward if he is successful. The whole book is occupied with the succession of exciting attacks and counter attacks, marvelous escapes, and ingenious attempts. Each is well told in itself and they all hang together after a fashion; but there is no progression, no development, no character; and the tone is gruesome, cruel, and somewhat depressing from beginning to end. It is not a tale that one cares to read again or to recall when the last page is finished.

In 1823 Hogg published *The Three Perils of Woman*. The little known, it is in reality his best book. He calls the production a series of domestic tales, and such they are, not a continuous narrative. The first two volumes contain one tale; Love, Leasing, and Jealousy are the perils that occupy the third volume.

Agatha, or Gatty, Bell is a maiden of sixteen who falls desperately in love with a young man who is worthy in every respect to be her husband; but, thru some maidenly notion that it is a sin to be in love at such a tender age, she rebuffs him. She falls into a decline thru the self-imposed renunciation, and she is sent to Edinburgh, where, it is hoped, the change will restore her spirits. To cheer her up, her cousin Cherry, a naïve girl, full of spirits, guileless and artless as a flower, is sent to bear her company. M'Ion, Gatty's lover, is the most intimate friend of her brother Joseph, hence they are brought into daily contact. Thru misunderstanding after misunderstanding, M'Ion finally believes that Gatty, who is really almost dead from love, despises him. In the reaction from his despair he falls in love with Cherry, asks her to marry him, and is accepted. Then the truth of the whole situation comes out, Cherry renounces her lover in favor of Gatty, the two are married, and Cherry dies of a broken heart.

Soon afterward a change comes over Gatty. She grows daily worse, has no bodily ill, but has frequent premonitions of her death at a certain hour on a certain day. At that very hour, with all the family about her, she dies. She is



laid out for burial but in the night starts up and shows signs of life. Gradually she recovers her physical strength, but is wholly without the least trace of intellect. The situation is even worse, for her soul seems to have departed with her mind, and she remains in a state that Hogg constantly compares to that of a vegetable. In this condition she is removed to a mad-house where she remains for three years. In the meantime a boy is born to her who, however, is a splendid little fellow and quite unaffected by his mother's mysterious malady. Three years afterward, to the very day and hour, she is seized with a paroxysm that leaves her unconscious for some time. Then she slowly recovers and becomes her old self again in every respect. Hogg's merits and defects as a story writer are startlingly shown in this book. Once, in order to divert Gatty, a burly, hot-headed, wholly ridiculous cousin is introduced by her parents to be her suitor. On the day of his introduction he gets into a drunken frolic, and the story is interrupted interminably, in order to describe the three duels that emanate therefrom. The story is divided into eight chapters or "Circles". After Gatty is recovered and the story is done, comes the eighth circle which narrates how the ribald cousin marries a lewd woman whom he afterwards learns is with child by her seducer. The whole purpose of this disjointed and irrelevant piece of coarseness is set forth in the phrase below.

I have shown by a simple relation, all founded on literal facts, that by yielding to its [love's] fascinating sway she [woman] is exposed to the loss of life—the loss of reason—the loss of virtue, honor and happiness.

Had these portions been omitted there would have been left a tale of wonderful originality and brilliancy. One biographer of the Ettrick Shepherd charges him with the total lack of ability to draw a character or to portray the heroic. The double charge is sufficiently refuted by this story. Daniel Bell, the droll, simple-hearted father of the heroine is a true son of Scotland, worthy to rank as a creation beside Andrew Fairservice, Osbaldistone, or Ritchie Monoplies. Equal skill is shown in the portraiture of Cherry. Her renunciation, her assumed buoyancy of spirit which lasts till after the wedding of the pair to whom she has sacrificed her happiness, her subsequent collapse and death—these form a picture of heroism and pathos that one will read far to meet again. The ghastly



situation on the night after Agatha's death when she apparently comes back to life, not a human creature but a horrid thing possessed of a demon is unquestionably powerful, however revolting. At the same time, excepting the disagreeable concluding circle, the story of her recovery and the process by which she gradually learns the events of her three years' lapse from reason thru the means of her little child is a beautiful picture of gentle sweetness. Take it all in all, the book is what most of Hogg's stories are, the work of genius untrammelled by the rules of art.

*The Confessions of a Fanatic* is an ingenious book which is at once an example of the best and the worst of Hogg's eccentric manner. It is divided into three parts, each of which in turn bears a double character. The first part, or Editor's Narrative, is one of the most exciting stories the author ever wrote. The feeling is intense, the situations powerfully described, and one character, tho a monstrosity, is superlatively drawn. Over all the long list of peculiar incidents culminating in a mysterious murder, Hogg throws that supernatural veil that makes the events of another world seem real to the eyes of this. But, at the very end, when all seems in a fair way to a satisfactory explanation, the principal personage disappears and the narrative ends abruptly as things sometimes end in life—with no clue to the mystery.

This was a favorite device of Hogg's, apparently a part of his belief as to the best way to produce an impression of reality. Most of his stories of the supernatural show no evidence that he ever thought that the reader would ask for a rational explanation.

Part 2 of the volume under consideration consists of the Confessions proper, supposed to have been written by the Fanatic who so mysteriously disappeared at the end of the Editor's Narrative. This story is more prolix than the other, more of a psychological study (a form of treatise not at all suited to Hogg's powers). For a few pages the interest of the reader is very keen. Soon he gets a hint or two that enable him to piece out all the rest of the narrative; but the author proceeds to re-narrate all the facts already introduced, but from a new point of view. Interest flags until a point is reached where the reader suddenly realizes the importance of a character who all along has seemed to be playing second

fiddle, but who in the end turns out to be the main figure of the book. At the last this figure disappears and the whole climax of Part 1 is repeated.

Part 3 is another editorial narrative, very brief, which tries to make the whole seem real but adds little that is new to the story. When all is said, what does the book amount to? One need not dwell here on the power of individual parts. The conception of the whole volume should engage our attention. The two great figures are the Fanatic and his double. The weakness, or strength, of the book, lies in the fact that the events are set forth as they occurred—for the time being there can be no doubt of that—but the author does not play the part of chorus. Did Stevenson get the idea of *Jekyll and Hyde* from this work of his countryman? The answer is idle, but at times one is tempted to believe that the whole situation of the latter story is there set down in the fullest detail. But we are not sure. Again, one is tempted to believe that the story contains nothing but a study of a particular case of insanity in which the double is the result of the fanatic's hallucinations; yet we are at once confronted by the ocular testimony of other people who had seen both persons at the same time. Or are we to take literally the belief that is attributed to the common folk of the neighborhood: that this person is actually the devil who compasseth all the earth to win one soul to hell? He possesses certain supernatural qualities, such as coming and going at will in opposition to the laws of nature; and he possesses the ghastly quality of being able to look into one's face, to read his mind completely, and as a result so to identify himself with that person that he loses his own outward resemblance and assumes the other's. In this way he goes about committing crimes in the other person's name.

The present writer acknowledges the wonderful power displayed in this book but hazards no opinion as to its meaning because he believes that none is correct. As will be recalled from a former chapter, Hogg was essentially a reporter, an imitator, with a dreamy sort of imagination, prolific, but not under control. If we judge from a careful study of Hogg's other work, we feel sure that Hogg heard this story, or dreamed it out in all its vividness of detail, and that he then set it down without having more than a partial idea himself

as to what it all meant. Powerful as it is, the reflection of the writer's own uncertainty constitutes its chief flaw as a work of art.

There is no continuity and no unity in *The Shepherd's Calendar*. It is merely a collection of short stories reprinted from *Blackwood's Magazine*. One exception is Number IV, *The School of Misfortune*, an essay whose tenor is suggested by the title and which foreshadows the *Lay Sermons*, written later in his career. Number XVIII, *Odd Characters*, is of a biographical nature and is mostly anecdotal. It contains the sketch of Will O'Phaup that has already been quoted in this volume. The other numbers of this score of sketches are stories of shepherd life in the Ettrick Forest.

Here, as elsewhere, Hogg shows but little imaginative creation in prose. Yet the stories are not devoid of characterization. The character drawing, however, is the work of an accurate copyist, not that of a creator. Hogg excels, in his short stories, always as a portrayer of situation, and in this respect his work is eminent to a degree. In *Mr. Adamson of Laverhope* the writer has come nearest to originating a demon in human shape which required the touch of genuine imagination to evolve it from whatever prototype may have passed under the Shepherd's observation. And the situation with which it ends—the open valley, the shepherds and their flocks, the sudden storm, the cloud-burst, deluge, and disaster—all this is portrayed in one grand burst of description which reminds one of that comprehension of the terrible force of nature that inspired Turner's picture of the Bass Rock.

*George Dobbin's Expedition to Hell* is noteworthy only because it illustrates in small compass Hogg's almost invariable method of dealing with the supernatural.

In 1832 Hogg planned the *Altrive Tales* in twelve volumes, which was to be a reprint of many of his stories together with some new ones. Thru the failure of the publisher only the first volume appeared, the principal contribution to which was *Captain John Locky*. A close comparison between *Captain Singleton* and *Captain Locky* would certainly be favorable to the latter. The method of each writer is the same. Neither rises above the grade of mere anecdotal literature. Hogg attempts to characterize the mad king of Sweden with only partial success. His hero, too, is constantly getting into dire



situations of peril from which he is always extricated by others, never by his own efforts. In this respect he falls below DeFoe's hero, tho the story is far above *Singleton* in interest.

Hogg's characteristic love of the supernatural crops out in the story in the mild form of mystery thrown over the birth of the hero. It is a mystery of such a nature that if the secret were known Locky's life would not be worth a pin's fee; and again and again he meets with a clue to his origin, only to be headed off to his own and the reader's disappointment.

Scott once said to Hogg that he never put enough time and trouble upon his stories. Hogg, like the great novelist whom he idolized, often found it difficult to end a tale. *Captain Locky* is a pitiful example. In the first place, the hero himself never learns the secret of his birth. In the second place, as if the solution of the mystery were an afterthought, Hogg reproduces a couple of letters received in response to an advertisement inserted in a newspaper by a curious person. Hogg did not stop to think that if the solution became known as he said it did it might just as easily have been made known to the captain at any previous time. To add to the chagrin of this anti-climax, the facts are narrated so briefly that all narrative interest is lost. Had Hogg ended with a little more care, the book would stand as high as any of DeFoe's, save always the immortal *Crusoe*.

Two other prose writings of Hogg's, not stories, however, require a word of notice.

Writes Lockhart of Hogg in the *Life of Scott*:

He died on the 21st of November, 1835; but it had been better for his fame had his end been of earlier date, for he did not follow his best benefactor until he had insulted his dust.<sup>1</sup>

Whoever reads Lockhart's attack on Hogg in *The Life* should read also *The Domestic Life and Manners of Sir Walter Scott*. The offensive passages that constitute the insult are as follows:

[After describing his last meeting with Sir Walter, Hogg says of his friend's subsequent condition.] He was described to me by one who saw him often, as exactly in the same state with a man mortally drunk, who could in no wise own or assist himself, the pressure of the abscess on the brain having apparently the same effect as the fumes of drunkenness.<sup>2</sup>

<sup>1</sup> Page 760.

<sup>2</sup> Page 135.



Hogg elsewhere says that Scott never drank to excess; and,

He had a clear head as well as a benevolent heart; was a good man; an anxiously kind husband; an indulgent parent, and a sincere, forgiving friend; a just judge and a punctual correspondent. I believe that he answered every letter sent to him, either from rich or poor, and generally not very shortly. Such is the man we have lost, and such a man we shall never see again. He was truly an extraordinary man—the greatest man in the world. What are kings and emperors compared with him? Dust and sand! And, unless when connected with literary men, the greater part of their names either not remembered at all or only remembered with detestation. But here is a name which, next to that of William Shakspeare, will descend with rapt admiration to all the ages of futurity. And is it not a proud boast for an old shepherd, that for thirty years he could call this man friend, and associate with him every day and hour that he chose.<sup>3</sup>

However ill-timed Hogg's figure of drunkenness, this passage shows that there was no intention to offend. The other offensive passage is more to be lamented.

Who was Lady Scott originally? I really wish anybody would tell me, for surely somebody must know. There is a veil of mystery hung over that dear lady's birth and parentage which I have been unable to see through or lift up; and there have been more lies told to me about it, and even published in all the papers of Britain, by those who *ought* to have known than ever was told about any woman that ever was born. I have, however, a few cogent reasons for believing that the present Sir Walter's grandfather was a nobleman of very high rank.

However one may interpret this, one may be sure that Hogg considered that he had said nothing especially disparaging about the character of Lady Scott. On the previous page he lauds her to the skies for her beauty, tenderness, and other excellent qualities. The quotation of a few further passages will make more clear the attitude of Hogg towards his patron and at the same time illustrate many details of his character.

I was indebted to him for the most happy and splendid piece of ballad poetry that I ever wrote. He said to me one day after dinner, "It was but very lately, Mr. Hogg, that I was drawn by our friend Kirkpatrick Sharpe to note the merits of your ballad *The Witch of Fife*. There never was such a thing written for such a genuine humorous humour, but why in the name of wonder did you suffer the gude auld man to be burnt skin and bone by the English at Carlisle? (for in the first and second editions that was the issue). I never saw a piece of such bad taste in all my life. What had the poor old carl done to deserve such a fate? Only taken a drappy o' drink too much, at another man's expense: which you and I have done often. It is a finale

<sup>3</sup> Page 118.

which I cannot bear, and you *must* bring off the old man, by some means or other, no matter how extravagant or ridiculous in such a ballad as yours; but by all means bring off the fine old fellow, for the present termination of the ballad is one I cannot brook." I went home and certainly brought off the old man with flying colors, which is by far the best part of the ballad. I never adopted a suggestion of his, either in prose or verse, which did not improve the subject.

Speaking of *The Spy*, Hogg says:

That work being long ago extinct, and only occasionally mentioned by myself, as a parent will sometimes mention the name of a dear, unfortunate, lost child, who has been forgotten by all the world beside.

[Scott read the proofs of *The Three Perils of Man*.] "Well, Mr. Hogg, I have read over your proofs with a great deal of pleasure, and, I confess, with some little portion of dread. In the first place, the meeting of the two princesses at Castle Weiry is excellent. I have not seen any modern thing more truly dramatic. The characters are strongly marked, old Peter Chisholme's in particular. Ah! man, what you might have made of that with a little more refinement, care, and patience! But it is always the same with you, just hurrying on from one vagary to another, without consistency or proper arrangements."

"Dear Mr. Scott, a man canna do the thing he canna do."

"Yes, but you can do it. Witness your poems where the arrangements are all perfect and complete; but in your prose works, with the exception of a few short tales, you seem to write merely by random, without once considering what you are going to write about."

"You are not often wrong, Mr. Scott, and you were never righter in your life than you are now, for when I write the first line of a tale or a novel, I know not what the second is to be, and it is the same way in every sentence throughout. When my tale is traditionary, the work is easy, as I then see my way before me, though the tradition be ever so short, but in all my prose works of imagination, knowing little of the world, I sail on without star or compass."

This brief memoir, which is so short that it can be read in an hour, has been quoted so fully, partly because of the publicity given to it by Lockhart, and partly because it is out of print and has never been reprinted. For the latter reason the following extracts from the *Lay Sermons* are here set down. This volume contains Hogg's only extensive attempt at the essay form of writing, and the style of it is interesting from comparison with his stories. The book is divided into eleven chapters as follows: Good Principles, Young Women, Good Breeding, Soldiers, To Young Men, Reason and Instinct, To Parents, Virtue the Only Source of Happiness, Marriage, Reviewers, and Deistical Reformers.

My design in all this is to reconcile my younger brethren of the human race to a state of old age to which they are all fast approach-

ing, and which appears terrible to them only because they have no experience of it.

Vice cannot be exhibited in detestable colours when the intention of the author is to make resistance meritorious. . . . Think, then, what mischief may be wrought in a youthful female mind by such pernicious representations of character. . . .

My first great injunction, then, is to Keep the Sabbath. Do not be seen flying about with gentlemen in gigs and carriages, nor walking and giggling in the fields; for each behaviour is lightsome, and highly disreputable. Attend Divine service once every Sunday at least, even though your minister should be a *bore* as too many of them are, repeating the same monotonous sentences from day to day, and from year to year. Still it is your duty to attend Divine worship, to join in praise and prayer with the community of Christians to whom you belong, and listen, reverently and attentively, to the word preached, as you know not whence a blessing may come, or when it may light.

But as attending on Divine service takes up but a small portion of the day, in directing your studies for the remainder of it I am somewhat at a loss. I cannot insist on your reading sermons, not even my own, for I never could do it myself, except Sterne's and Boston's, the two greatest opposites in nature. The Bible is by far the most inexhaustible book in the world, even laying aside its divine origin altogether. For its great antiquity, simplicity of narrative, splendour of poetry, and wise and holy injunctions, there is no work once to be compared with it; therefore, by all means, read your Bible, and attend to all ordinances of Christianity.

After advising in a general way not to introduce religion into general conversation, he says,

. . . . but, among friends, whose hearts and sentiments are known to each other, what can be so sweet or so advantageous as occasional conversation on the principles of our mutual belief, and the doctrines of grace and salvation?

I remember when I first entered into genteel society, which was not till after the year 1813, I thought it the easiest matter possible to gain the affection of every person of whatever age, and to live in habits of intimacy and friendship with them. Alas! how soon I found myself mistaken; for, to my astonishment, the very men with whom I had been so happy over night, who had crammed me with flattery more than I could hold—and it is a dish with which I am not very apt to be satiated—who had invited me to their houses, not on one day, but on every day that suited my convenience, would the next day, when I addressed them in the kindest and most affectionate way I was able, stare me in the face and shrink from the gloveless hand of the poor poet, without uttering a word.

In regard to dealing with children, he says:

Generosity would be the great virtue I should reward. Injustice, falsehood, cruelty, and ingratitude, would be almost the only crimes I

should punish. . . . I should promote in them the habits of industry, the bowels of kindness, and the virtues of patience and humility; and in every step of their progress I should teach them to love God for His goodness to the fallen race of Adam, to walk in his ways, and to understand his word.

Hogg was a great stickler for education; yet he says:

I know it will be regarded by many as total want of experience and discernment; but, as a pupil of nature, I must speak out my sentiments. I have a great aversion to college education; indeed, I hold it in utter contempt—and sorry am I that it should be regarded as necessary towards the entering on any of the learned professions; for why a young man who, by private tuition and diligence, has rendered himself, on examination, equal to or superior to any of the collegians, is not considered capable of performing the same duties, it is above my capacity to comprehend.

His reasons are summed up by the phrase,

I never saw any young man the better for it.

And he adds,

The whole parade of college education is a mere jumble of confusion.

In the breeding up your children in the way they should go, then, the first thing I most strenuously recommend is, the setting them a good example, and training them up in the fear, nurture, and admonition of the Lord. Teach them to know the value of a good education, and be grateful to those who are spending their time in the improvement of their minds and morals; to correct all the irregularities of their temper by the sweet influence of Christian Charity; to be respectful to their superiors, kind to their inferiors and equals, and benevolent to all mankind; and both the blessing of the Almighty, and the respect of their brethren of mankind, will accompany them all the days of their lives.

For upwards of twenty years I have mixed with all classes of society, and as I never knew to which I belonged, I have been perfectly free and at my ease in them all.

It is true the occupation of the legitimate reviewer is gone, and has devolved entirely on the editors of newspapers; while the old established reviews are merely a set of essays, such as these sermons of mine are.

It is no wonder it should be so, considering the woful want of candour, and miserable political party spirit, which have pervaded the whole of their lucubrations, from the highest to the lowest; and he who was long accounted the highest, was, in this respect, the worst of them all.

You, then, who handle the rod of literary correction, attend to one who has been both a reviewer and reviewed. Read and judge for your-



self; and if told that such and such works are exquisitely fine, and that everyone admires them, and that they are composed according to the very best of rules, then suspect a party spirit, and say not to yourself of your opponent in politics, "Now has mine enemy written a book." This is so decidedly the case in the present day that no criticism whatever is the least to be depended on. Why not, like a man of honour and candour, judge of the book solely by the effect it produces on yourself? and then you will rarely be wrong. . . . Your taste and imagination are exclusively your own, and therefore you should be ashamed either to laugh or cry, to abuse or to command, at the fiat of any save your own taste and judgement. . . .

If the author be but of their party in politics, and adhere a little to their dogmatic rules, there is nothing more required; they will point out to you, in perfect raptures, the finest and most brilliant passages. But if he be but of the adverse party, then "their enemy has written a book" and on him they fall tooth and nail. Of all the canting in the world there is none like the canting of criticism.

I speak not here of the delightful employment of giving up the mind and spirit to our Heavenly Father, of the soothing consolation of depending on superior strength, or of the rapturous heart; but I maintain that the worship of God by direct adoration, by reverence, or by devout meditation on His power, goodness and compassion is the natural result of our acquaintance with these divine perfections; and that if our reforming deists do not worship in sincerity as their Christian brethren do, what can we think but that their pretended knowledge is affectation, love of singularity, and pride of heart, and that they are in the gall of bitterness and bond of iniquity.

## CHAPTER 9

### LAST YEARS

AS we have seen before, Hogg was never quite satisfied with his condition as a farmer. So now, when everything pointed directly towards a happy settlement for life at Altrive Lake, he must needs ruin himself again by embarking upon more expensive ventures.

In 1822 the Shepherd turned his cottage over to his father-in-law, and himself removed to the adjoining farm of Mt. Benger. In order to stock it he called in all his literary debts and proceeded to attempt with a thousand pounds a task that required thrice the amount. Ill luck seemed to follow him. During the next few years he sank all that he made in the new farm. Seven years later, when he left it, the market price of sheep had fallen to such an extent that he was left penniless. He says:

Altogether I find I lost upwards of two thousand pounds on Mt. Benger lease—respectable sum for an old shepherd to throw away.

Hogg as usual exercised his own stubborn will in regard to Mt. Benger. He leased it against the advice of his best friends, and in spite of the fact that it had ruined two skilful farmers in the preceding six years. Scott writes in his *Diary*, December 27, 1827:

I have a letter from James Hogg, the Ettrick Shepherd, asking me to intercede with the Duke of Buccleugh about his farm. He took this burden upon himself without the advice of his best friends, and certainly contrary to mine. From the badness of the times it would have been poor speculation in any hands, especially in those of a man of letters, whose occupation as well as the society in which it involves him, are so different.

Hogg's life at Mt. Benger, however, was not without interest. He was busy at literary occupations during this period of seven years; and his house was *the* center of Yarrow hospitality.

Then the hospitality of Mr. and Mrs. Hogg was of the most liberal and genial kind. And it being known that the régime at Mt. Benger was according to the old Irish rhyme, "Hospitality, no formality, all reality", there was no lack of visitors to take advantage of it. As everyone was made welcome, whatever his errand or degree, we can well believe there were some who went merely to gratify curiosity.

There were many, however, of a different type. Good kind friends and literary acquaintances, not a few, gathered around the Shepherd's hospitable table. "In illustration of this", says the Rev. Henry Scott Riddell, "that on a day when a certain individual came to dine with the Shepherd and his family only, as they themselves expected, fourteen additional persons, before the day was done, dined in the house." . . . The day of the fourteen diners might be an extra chance day, but every morning, noon, and night, especially throughout the summer and autumn months, brought more or fewer to his house whom he loved to see. Those who came in carriages or on horseback, to call, or by appointment, were less difficult to deal with; because they came at regular hours; they had their refreshment and it was over; but those who haunted the hills and holms of Yarrow for their scenery, or its lakes and streams for their trout, came almost at all hours. Many, as well as the writer of this, have marvelled how Mrs. Hogg's patience became not oftentimes utterly exhausted; but if the lord of the little *bein ha'* was a poet whom nature, of her own free will, made generous, the lady was no less a philosopher versant in all the inexhaustible friendliness which supplies dry raiment to the wet, and food and rest to the weary, and the smile of welcome departed not from her countenance, nor the law of kindness from her tongue.

"To a friend", the Shepherd once said, "my bit hoose", looking back at it, "is e'now just like a bee-skep, fu' o' happy living creatures, an' nae doubt, like a bee-skep, it will have to cast some day when it can haud its inhabitants nae langer."<sup>1</sup>

Hogg was a firm believer in elementary education, and, to further it in his neighborhood, he established a little school upon his farm, and boarded the schoolmaster in his own house.

During Hogg's later years, both at Mt. Benger and after his return to Altrive Lake, he wrote many poems and short stories for the popular annuals of the day, some of which were edited by his personal friends. *The Anniversary* was edited by Allen Cunningham; others to which he contributed were *Friendship's Offering*, *The Forget-me-not*, *The Souvenir*, *The Book of the Seasons*, and *The Club-Book*.

In 1829 he returned from Mt. Benger to Altrive Lake, a sadder and a wiser man. But if Hogg was always meeting with financial disaster thru his own foolhardiness, he was also always quick to rise upon the crest of hope's wave. He was not long cast down but set about the task of redeeming his fortune thru his pen. He was at this time a regular contributor both to *Blackwood's* and *Fraser's Magazines*. It was soon after his return to Altrive Lake that he conceived the notion of the *Altrive Tales* which in turn led to his quarrel

<sup>1</sup> Mrs. Garden, page 176.

with Mr. Blackwood. It was to find a publisher that he set out in 1832 for London. The visit was a continuous ovation to Hogg and did much to gratify his vanity if it did not fill his purse. S. C. Hall, in his *Retrospects of a Long Life*, thus speaks of Hogg's visit to the metropolis.

The visit of the Ettrick Shepherd to London took place in the year 1832. It is scarcely too much to say that the sensation he produced in literary circles may be likened to that which might have been created by the temporary presence of Ben Nevis on Blackheath. A striking sight it was to see the Shepherd fêted in aristocratic *salons*, mingling with the learned and polite of all grades—clumsily, but not rudely. He was rustic without being coarse; not attempting to ape the refinement to which he was unused; but seeming perfectly aware that all eyes were upon him, and accepting admiration as a right.

Almost enough has already been said about the projection of the *Altrive Tales*. Hogg set out having no doubt of his ability to find a publisher, tho the easily found publisher was one whose later career showed him to be unworthy of trust. It may here be noticed that Hogg was not only unsuspecting, but also generous to a fault. Tho Cochrane failed after the publication of the first volume of the *Altrive Tales*, Hogg trusted him again in 1835 with the bringing out of *The Tales of the Wars of Montrose*. The kind desire to help Cochrane by entrusting to him the publication of a work that promised success influenced Hogg. Cochrane failed again, but not till a short time after the Shepherd's death.

When volume one of the *Altrive Tales* appeared, all the reviewers commented in favorable terms upon the tale of *Captain John Locky*, but most of them concerned themselves chiefly with the new version of the *Memoir* which contained the passages so offensive to Mr. Blackwood.

At last adversity began to tell upon the lively spirit of the Ettrick Shepherd. He had returned to Altrive Lake before the news of Cochrane's failure. When it came he was considerably affected and ill for some time, tho he soon recovered his accustomed spirits. During the whole of the last two years of his life, however, he was far from well.

In 1832, soon after the death of Scott, appeared Hogg's brief life of the author of *Waverley*. It has already been discussed in detail, but it may be of interest to add a few words concerning the long friendship between these two men, especially from Scott's side. Hogg writes, with himself in mind,



Although so shy of his name and literary assistance, which, indeed, he would not grant to anyone, on any account, save to Lockhart, yet to poor men of literary merit, his purse strings were always open, as far as it was in his power to assist them.

Scott writes in his *Diary*, February 15, 1826:

Poor James Hogg, the Ettrick Shepherd, came to advise with me about his affairs,—he is sinking under the times; having no assistance to give him, my advice, I fear, will be of little service. I am sorry for him, if that would help him, especially as, by his own account, a couple of hundred pounds would carry him through.

(May 14, 1826.) Hogg was here yesterday in danger from having obtained an accommodation of 100 pounds from Mr. Ballantyne, which he is now obliged to repay. I am unable to oblige the poor fellow, being obliged to borrow myself. But I long ago remonstrated against the transaction at all, and gave him 50 pounds out of my pocket to avoid granting the accommodation, but it did no good.

(February 3, 1827.) James Hogg writes that he is to lose his farm, on which he laid out, or rather threw away, the profits of all his publications.

(May 11, 1827.) Hogg called this morning to converse about getting him on the pecuniary list of The Royal Literary Society. Certainly he deserves it if genius and necessity could do so. But I do not belong to the society, nor do I propose to enter it as a coadjutor. I don't like your royal academies of this kind; they almost always fall into jobs, and the members are seldom those who do credit to the literature of a country. . . . Yet I wish sincerely to help poor Hogg, and have written to Lockhart about it.

Concerning another reference in the *Journal* to Hogg the editor writes the following:

As this is the last reference to the Ettrick Shepherd in the *Journal*, it may be noticed that Sir Walter, as late as March 23, 1832, was still desirous to promote Hogg's welfare. In writing from Naples he says, in reference to the Shepherd's social success in London, "I am glad Hogg has succeeded so well. I hope he will make hay while the sun shines; but he must be aware that the Lion of this season always becomes the Boar of the next. . . . I will subscribe the proper sum, *i.e.* what you think right, for Hogg, by all means; and I pray God keep farms and other absurd temptations likely to beset him out of his way. He has another chance for comfort if he will use common sense with his very considerable genius."

Hogg thus describes his last meeting with Sir Walter:

The last time I saw his loved and honored face was at the little inn on my own farm in the autumn of 1830. He sent me word that he was to pass on such a day, on his way from Drumlanrig Castle to Abbotsford, but he was sorry he could not call at Altrive to see Mrs. Hogg

and the bairns, it being so far off the way. I accordingly waited at the inn and handed him out of the carriage. His daughter was with him, but we left her at the inn, and walked slowly down the way as far as Mt. Benger Burn. . . . He leaned on my shoulder all the way, and did me the honour of saying that he never leaned on a firmer or a surer.

We talked of many things, past, present, and to come, but both his memory and outward calculation appeared to me then to be considerably decayed. I cannot tell what it was, but there was something in his manner that distressed me. He often changed the subject very abruptly, and he never laughed. He expressed the deepest concern for my welfare and success in life, more than I had ever heard him do before, and all mixed with sorrow for my misfortune. . . .

When I handed him into the coach that day, he said something to me which in the confusion of the parting I forgot; and though I tried to recollect the words the next minute I could not and never could again. It was something to the purport that it would be long ere he leaned so far on my shoulder again.

### Writes Mrs. Garden:

In April of 1835, he was in Edinburgh, and one still living can recall how he accompanied him from Gloucester Place, the residence of Professor Wilson, up to town, past the Queen Street Gardens, along George Street, and thence to the North Bridge. The Professor with two of his daughters convoyed the Shepherd, while his son and another walked on in front. Probably many a head was turned as the stately, picturesque figure of Christopher North, with his flowing yellow locks and his broad turned-over collar, passed along. Some, too, would say, "And that's the Ettrick Shepherd." James Hogg had once borne himself erect, and his step had been agile and light, and his figure had been familiar on Edinburgh streets for twenty years; but the Bard of *The Queen's Wake* was now past three score, and there were gray hairs where formerly there had been only golden brown. Still he walked with a firm step, pleased as he no doubt was, with the company of his loved Professor and the two handsome girls who accompanied him. The party separated near the University, and the Ettrick Shepherd was seen no more on Edinburgh streets.

"I see, on looking at my note-book that I went to Altrive in June, 1835, and met with a very kind reception indeed. I showed Mr. Hogg several pieces of poetry which I had received from various authors for my intended publication, on one of which he made some pencil alteration.

"Next day he, Mr. Marshall, and I went to fish in St. Mary's Loch. The wind was from the east, high and very cold. Mr. Hogg had not fished long till he broke his rod. 'It is surely a salmon', he exclaimed, 'for he had sic a weight that he would not move after taking the hook, but lay just like a stone at the bottom.'

"Having thus lost his fishing rod he left us and went home. . . .

<sup>2</sup> This letter from Mr. Shearer, and the two following are quoted by Mrs. Garden.

Mr. Marshall and I arrived at Altrive about 4 o'clock. This was the last time your father fished, so that I was the last who had the honour of fishing with him.

"Sitting together on the sofa he played several fine old Scotch airs on the violin, and regretted much that when he should be no more, a good many of the old Scotch tunes would be lost, because no one could play them now but himself.

"You may recollect", writes the poet's only son, "that he was for ten years a shepherd at Blackhouse, and I think he always looked back on these ten years as the happiest of his life. In the month of July before his death, he asked me to accompany him, one fine day on horseback, up the heights that separate Douglas Burn from Traquair. I was surprised to see him mount on horseback, for he had not done so for some years previously, but I guessed as we wended our way up Douglas Burn, past the old tower and the farmhouse of Blackhouse, where he had spent so many happy days, that he was taking his last look of them. We rode up to the stones that mark the graves of the seven brethren, alluded to in the old ballad, at the top of Glen Burn; and he took a long look at all the scenery that had been so familiar to him in days gone by. We then returned home, and I was right in my surmise, for he never saw Blackhouse again.

"The following August he felt pretty well, and he and I went up to Birkhill on the twelfth, he having permission as usual from the Earl of Weymss to shoot over his property there. My father was stronger and able to take more exercise than I expected on that occasion, and I almost hoped that his life might be spared longer than he anticipated.

"On our return journey to Altrive we came down between the Lochs and Ettrick. On our way we came to an opening where we got a glimpse of the valley of Ettrick, and that spot where used to stand the house in which he was born, and the church. He sat down and remained without saying a word for about half an hour. I did not speak to him, for I felt that the thoughts that were passing through his mind, were probably too solemn to be disturbed. He rose, and, without saying a word we proceeded on our way home."

"I<sup>3</sup> visited him on the 22nd of October, and almost daily till the 19th November. After this I was in the room in which he died, never took off my clothes, but rested occasionally on a sofa—never got home till the Saturday after the funeral.

"Mr. Hogg went to the moors with his dog and gun as usual about the latter end of August, but this seems to have been a kind of a last effort to bear up under the progress of his malady. He gradually sank under languor and debility, and by the 20th of October was confined to bed. From this time he was only once out of the room in which he died. About this time he was attacked by severe hiccup, which scarcely left him when awake, till sensation was almost gone. This distressing symptom so harrowed him that he seldom after this could speak freely; but he complained of nothing else, and said if it were not the hiccup he would be quite well, and said 'it was a reproach to the faculty that they could not cure the hiccup.'

<sup>3</sup> Alexander Laidlaw.



"Though he knew he was in imminent danger, he was averse to giving information to his friends. On the 12th I wrote a short note for the *Glasgow Courier*, which was copied into several other newspapers. At this time his ideas were correct, but a lengthened detail seemed too fatiguing for his mind. He spoke none after the morning of the 17th, and at 12 noon on the 21st he ceased to breathe."

The following letter is from P. Boyd of Innerleithen:

Mr. Hogg, although apparently in good health, had been ailing for some years previous to his death, with water in the chest. When this was announced to him by his friend, Dr. W. Gray from India, a nephew of Mr. Hogg's, he seemed to laugh at the idea, and pronounced it impossible as one drop of water he never drank. Notwithstanding, he very shortly after had a consultation with some of the Edinburgh medical folks, who corroborated Dr. Gray's opinion. Mr. Hogg, on his return from town, called upon me in passing, and seemed somewhat depressed in spirits about his health. The Shepherd died of what the country folks call black jaundice, on the 21st of November, 1835, and was buried on the 27th in the church-yard of Ettrick, within a few hundred yards of Ettrick House, the place where he was born. It was a very imposing scene to see Professor Wilson standing at the grave of the Shepherd, after everyone else had left it, with his head uncovered, and his long hair waving in the wind, and the tears literally running in streams down his cheeks. A monument has been erected to the memory of Hogg by his poor wife. At this the good people of the Forest should feel ashamed. Mr. Hogg was confined to the house for some weeks and, if I recollect aright, was insensible some days previous to his death. He has left one son and four daughters; the son, as is more than probable you are aware, went out to a banking establishment in Bombay some two years ago. Mr. Hogg left a considerable library, which is still in the possession of Mrs. Hogg and family. With regard to the state of his mind at the time of his death I am unable to speak. I may mention, a week or two previous to his last illness, he spent a few days with me in angling in the Tweed; the last day he dined with me, the moment the tumblers were produced, he begged that I would not insist upon his taking more than one tumbler, as he felt much inclined to have a tumbler or two with his friend Cameron, of the inn, who had always been so kind to him, not infrequently having sent him home in a chaise, free of any charge whatever. The moment the tumbler was discussed we moved off to Cameron's; and, by way of putting off the time till the innkeeper returned from Peebles, where he had gone to settle some little business matter, we had a game at bagatelle; but no sooner had we commenced the game, than poor Hogg was seized with a most violent trembling. A glass of brandy was instantly got, and swallowed; still the trembling continued, until a second was got which produced the desired effect. At this moment the Yarrow carrier was passing the inn, on his way to Edinburgh, when Mr. Hogg called him in, and desired him to sit down till he would draw an order on the Commercial Bank for twenty pounds, as there was not a single penny in the house at



home. After various attempts he found it impossible even to sign his name and was, therefore, obliged to tell the carrier that he must of necessity defer drawing the order till next week. The carrier, however, took out his pocket book, and handed the Shepherd a five-pound note, which he said he could conveniently want till the next week, when the order would be cashed. A little before the gloaming, Mr. Hogg's caravan cart landed for him, which he instantly took possession of; but, before moving off, he shook hands with me, not at all in his usual way, and at the same time stated to me that a strong presentiment had come over his mind that we would never meet again. It was too true. I never again saw my old friend the Shepherd, with whom I had been intimately acquainted since the year 1802.

In 1824 Christopher North wrote:

My beloved Shepherd, some half century hence, your effigy will be seen on some bonny green knowe in the Forest, with its honest face looking across St. Mary's Loch, and up towards the Gray Mare's Tail, while by moonlight all your own fairies will weave a dance around its pedestal.

This prophecy is fulfilled. On June 28, 1860, was unveiled the huge statue of the Shepherd at the head of St. Mary's Loch, a monument that is now visible for miles in every direction. On July 28, 1898, the Edinburgh Border Counties association erected another monument to mark the site of the cottage in which Hogg was born; and upon the stone in Ettrick churchyard, erected by his wife, is the following inscription:

Here lie the mortal remains of James Hogg, the Ettrick Shepherd, who was born at Ettrickhall in the year 1770, and died at Altrive Lake, the 21st day of November, 1835. This stone is erected as a tribute of affection by his widow, Margaret Hogg.

Of the monuments erected to the memory of this sweet singer none is so great, and let us hope that none is so lasting, as that represented by the fulfilment of his own earliest wish: that he should write songs that would still be sung in his native valley. Such is the case. The present writer cannot refrain from a personal anecdote. Once he arrived at Moffat, *en route* for St. Mary's Loch on a day when no coach departed, and he was carried over the mountains in a private conveyance. It was a cold day of driving rain not conducive to conversation. Scarcely a dozen sentences passed between him and the driver till that high wall on the left of Moffatdale was reached that still shows the print of "Claver's devil horse". It was pointed out by the driver, and he also related in detail

the narrative of the trip to Loch Skene taken by Scott in company with Hogg and the Laird of Rubislaw. At every turn the driver had a new tale of the Ettrick Shepherd, and now and then he sang one of his saddest songs to the mournful accompaniment of the rain. When we came in sight of Chapelhope he launched into a full description of what had once happened there. He had not gone far when I slipped a book from my pocket and let him see the title. I cannot repeat the enthusiastic Scotch phrases with which he praised the habit of carrying *The Brownie of Bodsbeck* as a traveling companion. He became more talkative than ever, seemed familiar with most of what Hogg had written, and warned me of many places in the neighborhood that I must not fail to visit.

This proved not to be a unique experience. As I went to and fro along the sister valleys, again and again I met with peasants who thought the Ettrick Shepherd's a name to conjure with. This fact is his great monument. Until recently it seemed as if in the outside world the name of Hogg, except to students of literature, would pass into oblivion along with that of Wilson; but the Forest still holds his fame secure.

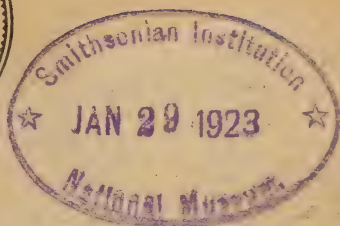








# INDIANA UNIVERSITY STUDIES



Study No. 55

STYLOLITES: THEIR NATURE AND ORIGIN. By PARIS  
B. STOCKDALE, Instructor in Geology, Ohio State Uni-  
versity.

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## Preface

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THE principal reasons for the preparation of this study are: (1) to present a thoro review of the work which has been done by both American and foreign investigators on the study of stylolites; (2) to present for the first time a detailed discussion of the stylolites of the Indiana limestones, especially those found in the well-known commercial stone, the Salem limestone (known by the trade name, Bedford, or Indiana Oölitic limestone); (3) to present evidence which conclusively establishes the origin of stylolites.

The writer wishes to express his obligations and thanks to the following persons: Professor E. R. Cumings, of the Department of Geology, Indiana University; Professor H. F. Cleland, of the Department of Geology, Williams College; Professors Clyde A. Malott and W. N. Logan, of the Department of Geology, Indiana University; and Professor J. Ernest Carman, of the Department of Geology, Ohio State University.

# Stylolites: Their Nature and Origin

A Study with Special Reference to Their Occurrence in  
Indiana Limestones

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## Part I. Introduction

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THERE are few of the minor, yet important, geologic phenomena whose explanation has been as unsatisfactory and under as much controversy as that of stylolites. They have been observed and described since the middle of the eighteenth century; yet today their manner of origin is held in doubt by many scientists.

### GENERAL CHARACTERISTICS OF STYLOLITES

Stylolites consist of a series of alternating, interpenetrating columns of stone which form an irregular, interlocked parting or suture in rock strata (see Figs. 1, 2, 3, and 15). In their most common occurrence they are found along the bedding or lamination planes of limestone, resulting in an intricate interteething of the rock by the alternating downward and upward projection of the columns of one layer into the opposite. The length of these columns varies from a small fraction of an inch to a foot or more. The width is as variable as the length. Oftentimes the union of the stone at a stylolite-parting is so firm that the rock will split more readily elsewhere than along this jagged suture. Where this parting is cut across, as in the wall of a quarry, it presents a rough, jagged line (see Figs. 3, 15, and 26). To such a line the terms "stylolite-seam" or "stylolite-line" may well be given. Because of the intricate interlocking of the columns, these lines have been compared by Vanuxem (1838, p. 271)<sup>1</sup> to the sutures of the human skull (see Fig. 16).

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<sup>1</sup> Reference to literature will be made by giving the name of the writer, date of publication, and page. The title of the paper and name of the publication can be obtained by consulting the bibliography.

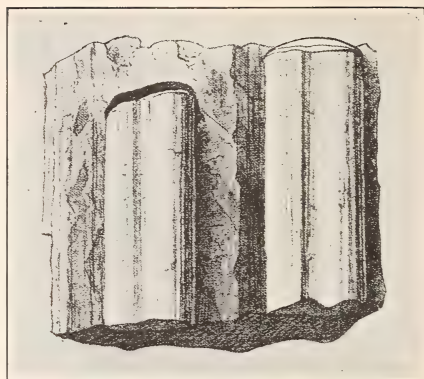


FIG. 1.—Stylolites in the Muschelkalk, showing striated side-surfaces and clay caps. From Rüdersdorf, near Berlin. Original in Marburg Museum. (From Kayser's *Lehrbuch der Geologie*.)

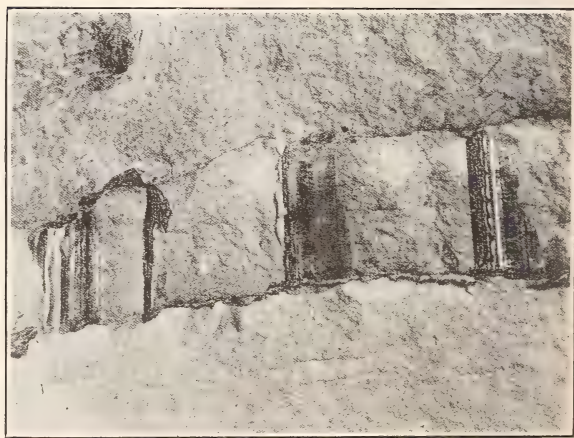


FIG. 2.—Large, perfectly formed stylolites of the Salem limestone. Note the slickensided side-surfaces and the clay caps of the columns. One-sixth natural size. From a quarry of the Consolidated Stone Company, Dark Hollow district, Lawrence County, Ind.



FIG. 3.—Typical, jagged stylolite-seam in the Salem limestone. From a quarry of the Consolidated Stone Company, Dark Hollow district, Lawrence County, Ind.



FIG. 4.—Small stylolite-surface in the Salem limestone, showing the characteristic roughness which, in itself, has the physical appearance of solution. The white portions are broken-off stylolites; the black, residual clay.



Where the stone has been split along a stylolite-parting, an extremely irregular, pinnacled surface is presented (see Figs. 4, 5, and 6). The term "stylolite-surface" might well be applied to such. The term "stylolite" (from the Greek *στυλος* meaning "column") applies to each individual, penetrating column. Thus it is seen that a stylolite-seam is made up of many stylolites whose direction of penetration, with few exceptions, is at right angles to it.

Stylolites are always characterized by two principal features:

1. An ever-present clay cap which comes to rest at the end (see Figs. 1, 2, 6, 11, and 26).
2. Parallel fluting, or striations, on the sides (see Figs. 1, 2, 5, 11, and 34).

The clay cap is usually thin, varying in thickness with the length of the stylolite and the composition of the stone. The caps of very small stylolites are mere films; those of long stylolites are sometimes as much as one-half inch or more in thickness. The stylolites of impure limestones and dolomites bear thicker caps than those of purer stone. The color of the cap varies usually from brown to black.

The fluting on the sides of stylolites often resembles the slickensides of fault planes. These striations are parallel with the direction of the penetration of the stylolites. The sides of the columns are usually slightly discolored with a thin film of clay. The sides often converge, but are commonly parallel, or nearly so.

Downward-penetrating stylolites are projections of the overlying stratum and show the same lithologic characteristics; while upward-penetrating stylolites bear the same relationships with the underlying stratum (see Fig. 26). The rock strata above and below a stylolite-seam appear undisturbed.

Stylolite-seams usually begin as a barely noticeable, smooth crevice or suture, grading from a slightly undulating seam into a finely toothed crevice—the teeth gradually increasing in size until typical stylolites appear (see Fig. 16). The stylolite-seam at both ends grades out into a fine suture which gradually disappears in the hard rock. The length of stylolite-seams varies from a few feet to several rods. Thus, stylolite-



FIG. 5.—Block of Salem limestone split along a large stylolite-seam. Note the slickensided side-surfaces of the exposed columns (marked by the ruler).

partings are sometimes several square rods in area. Some partings are so small, however, as to have an area of only a few square feet. Single, isolated stylolites are never found. They occur only as a series of alternating columns making up a stylolite-parting.

Stylolite-seams run most commonly in a horizontal direction, or nearly so, and parallel with the lines of stratification. Occasionally they have been observed running obliquely and even perpendicularly (see Fig. 17). They are also known to

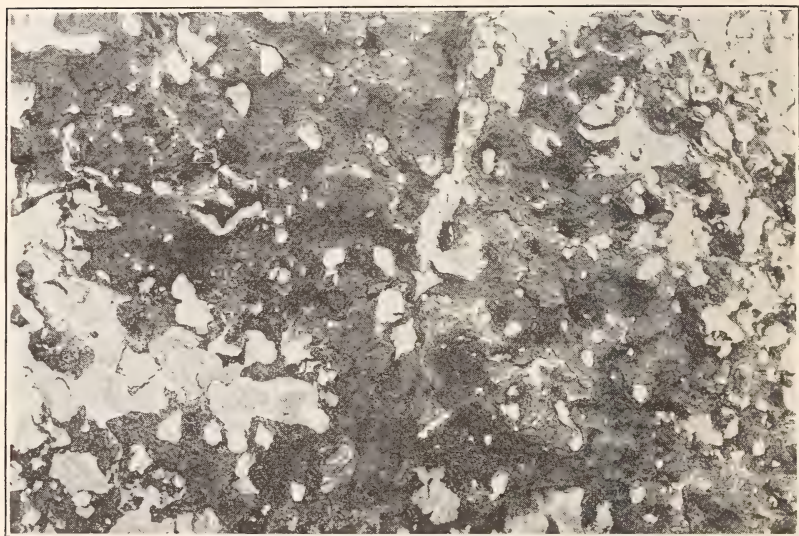


FIG. 6.—Stylolite-surface in the Mitchell limestone, showing the thin deposit of black residual clay. The white spaces result from broken-off stylolites, and show the irregular outline of the columns.

cross one another. The chief characteristics of the stylolites are the same regardless of the direction of the seam.

Stylolite-partings are often very numerous and close together (see Figs. 16 and 32). In a single, thin stratum, there have been observed as many as a dozen or more lying directly one above the other with only a few inches of stone separating them. They have also been observed to lie one upon another and even to penetrate one another. In some stylolite-bearing strata, however, the partings are very rare and far apart.



## GEOLOGIC DISTRIBUTION OF STYLOLITES

Stylolites are found in several geologic formations thruout different parts of the world. In Europe their most extensive development is probably to be found in the Muschelkalk (Triassic)<sup>2</sup> of Germany. In America their occurrence is especially noticeable in the Mississippian limestones of Indiana, the Niagaran limestones<sup>3</sup> of New York, and the Ordovician marbles (Holston formation)<sup>4</sup> of Tennessee. Their presence, however, is by no means limited to the above-mentioned geologic strata. The Indiana limestones offer examples of the largest and best-developed stylolites in America.

The Muschelkalk of Germany probably presents the most complex stylolitic structures known. The American limestones, as a whole, show less complicated stylolites. The Tennessee marbles, however, exhibit many complexities.

An important conclusion derived from a study of the geologic distribution of stylolites is that they are present only in carbonate rocks—varieties of limestones, dolomites, and marbles. Their occurrence has *not* been observed (1) in clastic rocks—conglomerates, sandstones, and shales (with the possible exception of highly calcareous sandstones and shales, in which the percentage of soluble carbonates is extremely high); (2) in igneous rocks; (3) or in metamorphic rocks other than carbonate types.

EARLIEST OBSERVATIONS OF STYLOLITES AND  
TERMS APPLIED TO THEM

The earliest mention of stylolites appears to have been made by Mylius, in 1751, who described them as “Schwielen” and spoke of them as resembling “versteinert Holz”. Freiesleben, in 1807, spoke of the phenomenon as “zapfenförmige Struktur der Flözkalksteine”, and Hausmann later referred to it as “Stängelkalk”.

<sup>2</sup> The most extensive paper treating of the stylolites of the Muschelkalk is that of Wagner (1913, pp. 101-128). Other late writers are Fuchs (1894, pp. 673-688), Gümbel (1882, p. 642; 1888, p. 187), Reis (1901, pp. 62-92; 1902, p. 157), Rothpletz (1900, pp. 3-32).

<sup>3</sup> A detailed discussion of the stylolites of American geologic formations has never been written. Earliest observations were made in the Niagaran limestones of New York. They have been described by Eaton (1824, p. 134), Bonnycastle (1831, p. 74), Vanuxem (1838, p. 271; 1842, pp. 107-109), Emmons (1842, p. 111), Hall (1843, pp. 95, 96, 130, 131), Marsh (1867, pp. 135-143).

<sup>4</sup> The most recent paper upon the stylolites of the Tennessee marbles is that of Gordon (1918, pp. 561-569). This discussion is very brief and not detailed.



The first mention of stylolites in America was made by Eaton (1824, p. 134), who, considering the structures to be of organic origin, named them "lignilites". Vanuxem (1838, p. 271), ascribing to stylolites an origin due to the crystallization of Epsom salts, gave them the name "epsomites". The terms given by Eaton and Vanuxem were used for some time. Hunt (1863, p. 632), accepting the explanation given by Vanuxem, used the term "crystallites". Stylolite-seams are popularly spoken of by quarrymen of the Indiana limestone districts as "crow-feet" or "toe-nails" (Hopkins, 1897, p. 142; Hopkins and Siebenthal, 1897, p. 305).

The above-mentioned terms are not used by scientists of today because they imply an origin which has not been confirmed. The term "stylolite" was given by Klöden (1828, p. 28) who thought the structure to be a distinct species of organism under the name of "*Stylolithes sulcatus*" (from the Greek *στυλος*, meaning "column"). Klöden's term is now generally accepted because it suggests a meaning descriptive of the phenomenon.

The two German terms "Drucksuturen" (pressure-sutures) and "Stylolithen" are used by some scientists as referring to analogous structures, and by others as referring to different, but similar, phenomena. A detailed discussion of this is taken up in the following chapter.

## Part II. Review of Previous Investigations

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EVER since stylolites were first mentioned the question of their nature and origin has been under controversy. Numerous investigations of them have been made, and several theories of their origin have been presented. The most exhaustive and conclusive studies have been made by German scientists. Publications by American observers have been few and are less satisfactory. The writer wishes to present a complete summary of the investigations of both American and foreign writers on the question of stylolitic phenomena.

### PHENOMENA SIMILAR OR ANALOGOUS TO STYLOLITES

A review of previous studies made of stylolites necessitates a consideration of at least two phenomena whose nature, origin, and relation to stylolites have been under discussion. These are the phenomena of the so-called "Drucksuturen" (pressure-sutures) and "Gerölleindrücke" (impressed, or pitted, pebbles). Some observers have suggested that the origin of the often-noticed "cone-in-cone" structures may be related to that of stylolites.

#### 1. "Drucksuturen"

The term "Drucksuturen" has been commonly used by German scientists as applying to the irregular, finely serrated, jagged lines, or sutures, common to many thick limestones and dolomites of Germany, and which in America are especially characteristic of the Tennessee marble. These veins are brown, red, black, or gray in color, depending in part upon the color of the rock containing them. Their course is usually irregular; so that they often bear an especially close resemblance to the sutures of the human cranium (see Fig. 16). The distinction between "Drucksuturen" and "Stylolithen" has been made by many German scientists, especially Rothpletz (1900, pp. 3-32), as follows: the individual, interlocking serrations of "Drucksuturen" are short in length, usually not more than one-half to three-fourths of an inch, giving a fine, narrow vein; the interlocked parts, instead of

being distinctly columnar in form with parallel sides, as are stylolites, are often more or less conically pointed (see Figs. 14 and 16). As in the case of stylolites, "Drucksuturen" are characterized by the ever-present clay partings (oftentimes only minutely visible) and the finely striated side-surfaces of the interpenetrated parts. The primary distinction, therefore, between "Drucksuturen" and stylolites, is one of size.

Many early investigators held "Drucksuturen" and stylolites to be of different origin. The latest to distinguish sharply between the two was Rothpletz (1894, 1900). In his most recent discussion he arrived at the conclusion that "Drucksuturen" and "Stylolithen" are "morphologically and genetically" quite different—the first is the result of rock pressure and solution in the hardened limestone mass; the second, the result of the pressure of the overlying sediments in a plastic, unhardened limestone deposit. The associated clay film of the "Drucksuturen", according to Rothpletz, is the solution residue of the dissolved lime mass. Rothpletz came to this conclusion after a careful study of the fossils found with the phenomena, which showed distinct signs of corrosion. Examples of fossils which were partially removed, or entirely penetrated by the teeth of the "Drucksuturen" were observed.<sup>1</sup>

The most recent investigators, especially Fuchs, Reis, and Wagner, hold "Drucksuturen" and "Stylolithen" to be analogous phenomena, and do not accept the distinction made by Rothpletz. They attribute to both phenomena the same origin and consider "Drucksuturen" merely as "young" stylolites—the beginnings of typical stylolite-seams.

## 2. "Gerölleindrücke" (Impressed, or Pitted, Pebbles)

Occurring in conglomerates of various geologic ages are found pebbles marked with depressions, or pittings, the origin of which probably has a bearing upon that of stylolites. These impressions are of two principal kinds: (a) one which bears evidence that it was produced by the squeeze, or pressure, of the contacting pebble, since the impressed pebble is highly fractured, the fractures radiating from the center of the pitting (see Fig. 7); (b) the second, a smooth, sharp type of pitting, which was apparently formed from the actual hollowing out and removal of the material formerly

<sup>1</sup> The work of Rothpletz on "Drucksuturen" is carefully reviewed by Wagner (1913, pp. 102, 103, 109). A discussion of Rothpletz's theory as to the origin of the so-called "Stylolithen" is taken up later, under the heading "Pressure Theory", p. 28.

occupying the depression (see Fig. 8). Pebbles bearing this type of indentation are usually not distorted or fractured. Some impressions, however, appear to be a gradation between, or combination of, the two above-mentioned types. The principal theories of their origin are two in number: (1) that



FIG. 7.—Fractured type of impressed pebble from the Karbonformation. Original in Marburg Museum. (From Kayser's *Lehrbuch der Geologie*.)

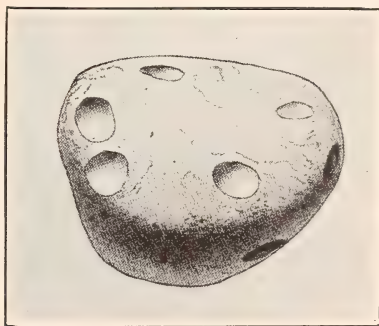


FIG. 8.—Solution type of impressed pebble from the Nagelfluh. (From Kayser's *Lehrbuch der Geologie*.)

they are a result of a mechanical force; (2) that they are a result of chemical action—the solution of the one pebble at the point of contact of the other. Some investigators believe the feature to have resulted while the pebbles were in a plastic, or semi-plastic state.<sup>2</sup>

<sup>2</sup> Early suggestions of this "plastic theory" were made by Hitchcock: *Geology of Vermont*, I, p. 28; *Proc. Bost. Soc. Nat. Hist.*, VII, pp. 209, 353; XVIII, p. 97; XV, p. 1; XX, p. 313; *Amer. Jour. Sci.*, 2d Series, XXXI, p. 372.



**GEOLOGIC OCCURRENCE.** The conglomerates which have attracted particular attention because of the occurrence of impressed pebbles are: the Nagelfluh (Tertiary) of Germany; the Devonian conglomerate of Scaumenac Bay, Province of Quebec; the Quaco conglomerate, of Quaco, N.B.; and the Bunter conglomerate (Triassic) of England. The occurrence of impressed pebbles, however, is by no means limited to the above-named formations. The most extensive studies of the phenomenon have been made in the Nagelfluh by German investigators.

**PREVIOUS INVESTIGATIONS AND THEORIES OF ORIGIN.** The first to mention impressed pebbles appears to have been A. Escher v. d. Linth, who, in 1833, described those of the Nagelfluh. Von Dechen, as early as 1849, discussed their presence in the Buntsandstein. The solution theory of their origin was first suggested by Sorby (1863, p. 801). His views may be summarized as follows: The impressions are formed, not so much by a mechanical hollowing out, as by chemical solution. Pressure creates heat, which in turn increases the possibility of greater solution. Thus, at the point where two pebbles are pressed against each other, active solution and removal of mineral matter takes place. Continued pressure results in continued solution and a consequent deepening of the depression. Sorby's explanation was confirmed experimentally by Daubrée.

The most exhaustive study of impressed pebbles of the Nagelfluh was made by Rothpletz (1879, 1880). His results show a special connection with the origin of stylolites. He pointed out the occurrence of two limestone pebbles impressed into one another, in which the contact, instead of being marked by a sharp line, showed a minute, jagged interteething of the two stones (see Figs. 9 and 10). Since the pebbles were of different colors, the alternating interlocking of the minute teeth was easily discernible. The teeth were covered by a thin coating of iron stain. Rothpletz (1880, pp. 191-192), accepting Sorby's theory, summarized his explanation as follows:

While in general the one pebble received, at the point of contact of the other, an impression as a result of the solution of the lime by carbonic acid, yet, certain places withstand this solution better than others so that such places penetrate the opposite sides as pointed projections, thereby forming a sort of teething between the two pebbles.

This phenomenon, Rothpletz pointed out in his later papers (1894, 1900), is analogous to that of "Drucksuturen", even in the smallest details. However, he distinguished sharply between "Drucksuturen" and stylolites (see p. 16).

After a careful study of the pitted pebbles of the Bunter conglomerate of England, Reade (1895, pp. 341-345, pl. XI)

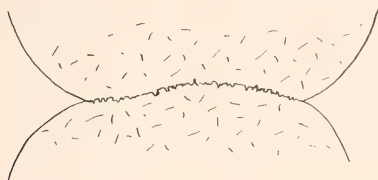


FIG. 9.—Diagram of the contact of two impressed limestone pebbles, showing the minute interteething. Four times natural size. See Fig. 10. (After Rothpletz.)

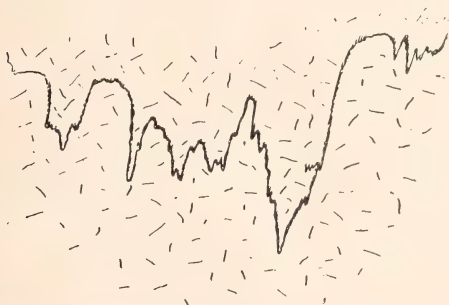


FIG. 10—Enlargement, 50 diameters, of the intertoothed contact of two impressed limestone pebbles, Fig. 9. (After Rothpletz.)

gave a complete summary of the evidence pointing to the theory that the "pitted pebbles are the result of contact-solution, the water being retained at these spots by capillary attraction". His most important points follow:

If the pittings or depressions were due to mechanical pressure, the material of the pebble which was "indented" would show signs of distortion. This it never does in any of the pebbles I have examined. A reference to the photograph (pl. XI) will show this clearly. . . . The material formerly occupying the depression has been removed, not displaced.

Out of six pebbles examined only one showed signs of fracture.

It is quite evident that the "fractures" are simply joints, such as may be found in many pebbles. . . . Fractures are a sign that the material of the pebble is rigid, and that it cannot be squeezed out of shape. Their existence is, to a certain extent, evidence against the mechanical theory.

The indenting pebbles perfectly fit the indents of the pebbles. If the indents were the result of mechanical movement this would not be likely to happen in all cases. . . . When the indenting pebbles are removed the cup, or depression, is seen to be smooth, frequently having a deposit of silica over the surface (the pebbles were quartzite), sometimes one of iron.

The pittings are, in the more marked cases before me, principally confined to one side and the edges of the pebbles. The opposite side often has adherent somewhat loosely cemented sand and small pebbles. I take this, which is on the flattest side, to be the bed of the pebbles, and the pitted surface to be the top surface. Why should this be the case on the mechanical assumption?

This writer showed that the maximum amount of static pressure at any time on the Bunter rocks would not have been sufficient to crush or disturb the pebbles of the conglomerate. There is practically no evidence of lateral pressure in the locality.

But we have positive evidence that at the points of contact of the pebbles solution and deposit have been going on. In most of the depressions there is a deposit of silica which smooths the surface of the depression and unites the grains of the rock. In some places where a joint or crack traverses the depression, the silica fills it up. The grains of silica, where they are seen in the depressions of true quartzite pebbles, show like a mosaic, and appear to be flattened or cut off on their upper surface. I think it extremely probable that solution and deposit have gone on alternately. The solution of the silica has taken place, there is evidence on all hands, including the adherent sand and gravel, for solution must precede deposit. Solvent action would concentrate itself on the continually damp spots, and these are the points of contact of the pebbles, especially on the upper surface of the larger pebbles.

Gresley (1895, p. 239), in a letter to the *Geological Magazine*, described an indented pebble of the Bunter conglomerate, which he claimed bore unmistakable evidence that the impressions were produced by squeeze and pressure, inasmuch as the pebble was not only severely fractured into four or five pieces, but was also minutely faulted. The lines of fracture radiated from typical indentations upon opposite sides of the pebble.

In a paper read before the Geological Society of America, J. M. Clarke (1915, p. 60) discussed the deformation of pebbles of the Devonian conglomerate of the Scaumenac Bay region, and suggested that the solution theory of Sorby is inadequate and that the "effects described are in a large part actually due to forcible contact resulting from internal friction".

**CONCLUSIONS.** The controversy over the origin of impressed pebbles may lie in the fact that the indentations discussed are of at least two kinds, each of which may have a distinct origin. The fractured and distorted type of pebbles shows evidence of having been subjected to the pressure and squeeze of one another, and the origin of the impressions may be, for the most part, a mechanical one. However, the sharp, smooth impressions of the non-distorted, non-fractured type of pebble are undoubtedly of chemical origin—a result of the solution of one pebble at the point of contact of the other. Sufficient evidence in support of this theory has been produced by Sorby, Daubrée, Heim, Rothpletz, and Reade. The theory is accepted by Fuchs, Reis, Wagner, Kayser, and Geikie.

## THEORIES OF THE ORIGIN OF STYLOLITES

### 1. Theories Regarded as Unestablished

The earliest theories of the origin of stylolites were quite hypothetical and had little evidence in their support. Most of them are today entirely rejected; a few have a slight following. The following is a grouping of the theories, with their principal advocates, which today are regarded as unestablished:

#### *a.* Organism Theory

Eaton, 1824

Klöden, 1828

Leube, 1850

Quenstedt

#### *b.* Crystallization Theory

Bonnycastle, 1831

Vanuxem, 1838, 1842

Emmons, 1842

Hall, 1843

Rossmässler and Cotta, 1846

Meyer, 1862

Hunt, 1863



- c. Erosion Theory
  - Plieninger, 1852
  - Quenstedt, 1853
  - Weiss, 1868
  - Hopkins, 1897
  - Rinne, 1905
- d. Gas Theory
  - Zelger, 1870
  - Potonié, 1910
- e. Bitumen Theory
  - Alberti, 1858

ORGANISM THEORY. Among the earliest observers to propose an organic origin for stylolites was Eaton (1824, p. 134), who believed the columns to be fossil corals, and proposed for them the name "lignilites". Klöden (1828, p. 28), in observing the structures in the Muschelkalk at Rüdersdorf, regarded the feature as a fossil, and, altho in doubt as to the nature of the animal, proposed for it the name "*Stylolithes sulcatus*". In 1834 Klöden discussed their origin in more detail but found few followers. Leube (1850, p. 141) described stylolites as an animal with "kopffähnlicher Formation und anhängenden Saugorganen".

Of the many early investigators of stylolites, Quenstedt was one who changed his ideas several times. He at first suggested that the structures were due to the filling up of hollow spaces, or holes, made in the soft slime by the upward movement of mussel shells. Plieninger, in 1852, strongly refuted this theory.

CRYSTALLIZATION THEORY. This theory had its principal support among American investigators. The first to suggest the origin of stylolites as resulting from mineral crystallization was Bonnycastle (1831, p. 74). Basing his theory upon observations in the Niagaran and Trenton limestones, he regarded the structures as a "new mineral due to infiltration" and suggested that the "yellowish coating" was probably "a new variety of shale, in which there is a good deal of iron".

Vanuxem (1838, p. 271; 1842, pp. 107-109) claimed to have solved the mystery of stylolites and suggested that they were due to the crystallization of sulfate of magnesia in soft sediment at the time the rocks were deposited. The salts, after having been subsequently removed by solution, left their

moulds in the sediments to be filled in by the succeeding layer. In his 1842 report Vanuxem states

As their origin is due to sulfate of magnesia, for the sake of brevity they might be termed *epsomites*. The carbon which usually lines the cavities shows that the liquid which held the salt in solution contained bituminous matter.

Emmons (1842, p. 111) accepted the crystallization theory of Bonnycastle and Vanuxem, but suggested that, in some instances, strontium sulfate might have been the crystallizing agent. Hall (1843, p. 96) accepted the theory with modifications and suggested that the crystallization might in some cases have been due to carbonate of lime. Meyer (1862, p. 590), in support of the theory, proposed that gypsum might have been the agent of crystallization. He had detected columns coated with this substance.

Rossmässler and Cotta (1846, p. 128) compared stylolites with ice crystals (*Eisstängeln*) that form in the soil in winter and suggested a similar origin for both.

Hunt (1863, pp. 631-634), in describing the stylolites of the Trenton and Niagaran rocks, spoke of them as "crystal-lites" and proposed that in many cases sulfate of soda might have been crystallized instead of magnesium sulfate, as advocated by Vanuxem. He described examples "in which crystal-lites penetrate a mass of chert imbedded in the limestone" (Hunt, 1863, p. 633, Figs. 437 and 438).

**EROSION THEORY.** Plieninger (1852, p. 78) proposed an elaborate explanation of stylolites which, for some time, had quite a few followers. He suggested that the surface of the soft limestone ooze was first raised above water and, upon drying, was separated into blocks by shrinkage-cracks. Thru the action of rain, columns, protected by shells and other foreign substances, would result. After subsidence and further deposition of lime ooze, the whole would gradually become compact limestone with the enclosed stylolitic feature.

The fact that rain, under certain circumstances, may produce columns very similar in form to Stylolites had already been noticed, and this was doubtless one reason why Plieninger's theory gained so many adherents (Marsh, 1867, p. 137).

Quenstedt (1853, p. 71), aided by Fallati, proposed a theory similar to the one of Plieninger in which he likened

stylolites to "earth pyramids" which owe their columnar structure to a small stone or shell protecting the underlying soil, while the surrounding earth is washed away (Hopkins and Siebenthal, 1897, p. 306). This idea of Quenstedt was accepted by Weiss (1868, p. 728), and received its most recent support by Rinne (1905, p. 186).

In making a study of the Salem limestone of Indiana, Hopkins (Hopkins and Siebenthal, 1897, pp. 305-308) concluded that in all cases stylolite-seams mark bedding or stratification planes in the rock. He suggested that quite probably all are not due to the same cause.

Some look as though they were formed by cracks in the drying of the limestone mud, and others look like a rain or spray washed surface . . . and possibly the escape of gases, as advocated by Zelger, may have acted in some places.

**GAS THEORY.** The idea that escaping gases may have been a factor in the formation of stylolites was first suggested by Zelger (1870, p. 833). He considered the structures as due to "the escape of compressed gases through the soft plastic mass, and the later filling in of the passageways" (Hopkins and Siebenthal, 1897, pp. 306-307).

Zelger's theory had but few followers, one of whom was Potonié, who, in 1910, proposed that the organic substance of the slime, by further decomposition, created gas bubbles. If the gas would collect under a mussel shell in the lime ooze, then the shell would be shoved upward, and the cavity thus formed would be filled in from below, taking the form of a stylolite.

**BITUMEN THEORY.** Another and entirely different hypothesis as to the origin of stylolites was suggested by Alberti (1858, p. 292). Having observed the stylolites covered with a dark substance which he regarded as bitumen, he suggested that the columns were formed by drops of petroleum pushing their way upward in the rock which was yet in a soft, viscous state. The hardened petroleum would then serve as asphalt caps.

## 2. Two Principal Theories under Controversy

Two theories of the origin of stylolites have today a divided following among geologists. The first, the "Pressure Theory"—that stylolites are a result of the differential com-

pression of sediments while in the soft plastic state—has been offered several times with various modifications. The second, the “Solution Theory”—that stylolites are a result of differential chemical solution under pressure in hard rock—is the most recent explanation and today is generally held as most plausible, especially by recent German investigators. Because of lack of sufficient evidence in support of them, however, neither of these theories has received definite acceptance by American workers. The following is a grouping of the principal advocates of the two theories:

*a. Pressure Theory*

Quenstedt, 1837, 1861

Thurmann, 1857

Marsh, 1867

Gümbel, 1882, 1888

Rothpletz, 1900

*b. Solution Theory*

Fuchs, 1894

Reis, 1901, 1902

Wagner, 1913

**PRESSURE THEORY.** Quenstedt is the originator of the pressure theory, suggesting for the first time, in 1837, that stylolites may have resulted from compression of plastic sediment. After having changed his views in 1853, when he proposed a theory similar to the one of Plieninger, he went back to his original pressure idea, in 1861, and offered a rather elaborate explanation. He took the view that two beds of lime ooze overlying one another, separated by a layer of shells and a layer of clay, would be so compressed into one another that stylolites would result. The two beds, at the time of compression, would have different hardness because of the different times of their deposition (Quenstedt, 1861, p. 200).

Thurmann launched his pressure theory in 1857. He advocated the view that two lime layers lying one above the other, in a plastic state, would be differentially compressed into one another regardless of whether or not there were a clay layer between them. He also explained the “Geröllein-drücke” of the Nagelfluh (Tertiary) as a result of pressure while the pebbles were in a plastic state.

*Pressure Theory of Marsh.* Probably the most commonly accepted theory in America is that of Marsh (1867,



pp. 135-143), who advocated the view that stylolites were caused by a "slipping through vertical pressure of a part capped by a fossil against an adjoining part not so capped" while the rock was still in a plastic state. Marsh's theory is accepted by both Dana and Geikie in their textbooks.

Marsh made a study of the Niagaran limestones of New York, and published the most exhaustive work that has been done in America on the phenomenon. He presented the geologic conditions essential for stylolitic formation as follows:

Let us first suppose a quantity of fine carbonate of lime . . . slowly deposited under water, and, while still soft, shells and other organic substances scattered over it, and the whole then covered with a very thin layer of argillaceous mud. If, after this, the deposition of calcareous matter proceeds, gradually forming a second bed, its increasing weight will slowly condense the bed below. The shells beneath the clay layer will offer more resistance to vertical pressure than the material around them, and hence the latter will be carried down more rapidly, thus leaving columns projected into the bed above, each protected by its covering, and taking its exact shape from its outline.

If the shell, instead of lying horizontal, as in the above instances, has an oblique position, curved columns will generally be formed, the curvature being towards the upper edge of the shell and its amount depending upon the degree of elevation. Where the rock is not homogeneous, bent or even broken columns often occur, evidently caused by meeting with impediments, just as a nail is turned from its course when driven against an obstacle. . . .

The comparatively few stylolites extending from the upper layer of limestone into the lower are evidently formed essentially in the same way as those already described, though under somewhat different circumstances. Where the shape has been determined by a fossil, it will generally be found that this was deposited above the argillaceous layer rather than below it.

Important conclusions given by Marsh may be summarized as follows: (1) Stylolitic displacement took place in the rock before consolidation was completed. (2) Nearly all of the separate columns have on their summits a fossil shell which has accurately determined their shape. (3) When the columns stand at right angles to the stratification, they have been produced by vertical pressure resulting from the weight of the superincumbent strata. The comparatively few stylolite-seams which have different positions are due to lateral pressure. (4) The columns start from the junction of two beds of limestone, separated by a thin seam of argillaceous

shale, which, when later broken up, comes to rest as the clay caps at the ends of the stylolites. (5) The longer columns usually have the convex side of the shell uppermost; and the shorter ones, the reverse. When the shell lies obliquely on the column, the latter will, in most cases, be found curved, the degree of obliquity of the shell determining the amount of curvature.

*Experiment of Gümbel.* Believing, as did Quenstedt and Marsh, that stylolites are due to differential compression of sediments before consolidation, Gümbel (1882, p. 642) tried to prove his theory experimentally. In his explanation of stylolites, he placed the emphasis on the always-present clay cap at the ends of the columns. He suggested that they are always formed at the horizon of a clay or marl layer between two lime layers. By the drying out of this clay, cracks would be formed and the layer would be broken up. Pressure of the above, yet-plastic, lime ooze would force a portion of the broken clay parts to settle down into the underlying bed of plastic sediment, while another portion would be projected into the overlying bed.

In his experiment, Gümbel took a mass of plastic ooze, covered by a thin layer of clay, and placed over this a metal plate in which various shaped holes had been cut. Exertion of pressure upon this plate resulted in columns of the underlying plastic substance being pushed up thru the artificial holes of the plate. Continuing his experiment to prove his theory, Gümbel repeated the conditions; but, before exerting the pressure, covered the plate with another layer of plastic material. Upon application of pressure, columns of the mass below the plate were forced up into the overlying mass, and thus the figure of stylolites resulted.

Gümbel's experiment met strenuous objections from Rothpletz, Fuchs, Reis, and Wagner, who conclusively pointed out that it was insufficient to explain the origin of stylolites. Rothpletz showed that the physical basis of the experiment was not sound; that the clay cap took a rôle which it could not possibly play; that the clay layer, instead of being torn apart, would be compressed together by the weight of the superimposed layer. Gümbel's experiment and theory failed to explain the occurrence of horizontal stylolites and other complexities.

Fuchs pointed out that the conditions of Gmbel's experiment were by no means similar to those of nature; that they were merely mechanical conditions; and that the power of the pressure was that of the experimenter, a thing external from that occurring in nature, and the experiment was thus not a result of a natural reaction. Fuchs raised the questions: "By what in nature would the all-important, stiff, metal plate be represented?" and "By what in nature would the necessary extra force of pressure be supplied?" He also insisted that had Gmbel, after placing the metal plate between the two layers of plastic material, left the experiment to itself, no columnar projections would have resulted, and the experiment, thus, would have been a failure.

*Pressure Theory of Rothpletz.* The most plausible pressure theory is the one offered by Rothpletz (1900, pp. 3-32), who suggested that the necessary differential compression of sediments to produce stylolites resulted from a differential and irregular hardening of the plastic mass brought about by the introduction of a cementing medium, at first unevenly distributed. Rothpletz's principal points may be summarized as follows:

1. Stylolites give no indications pointing to any sort of essential chemical activity. The fossils which often crown the columns are constantly preserved whole, as are those found in other portions of the limestone. There was no case observed (by Rothpletz) where the larger fossils of the stylolite-bands were considerably corroded.

2. The lime must have been spongy and plastic, and the lime grains must have been not entirely cemented. The formation of stylolites in compact, completely hardened lime is not possible.

3. If the mass of plastic material were of uniform hardness, and it were compressed together, the result of the compression would not be differential. However, if a hardening of portions of the lime ooze were brought about by the secretion of a cementing medium, then compression of the overlying mass would little affect these hardened (cemented) parts, and they would stand projected as columns, or pegs, into the above, yet-soft mass. The overlying sediment would sink down between the hardened portions, and the sides would be fluted, or striated, by the grains (of the cemented

columns), in the direction of the pressure. If a cemented portion, while being compressed into the above soft mass, should strike another partially consolidated part, then this compression would be lessened, thus explaining the differing lengths of stylolites of the same seam.

4. Since it is possible to have pressure exerted in directions other than vertical, stylolites may also form in an oblique, or even horizontal, direction. The clay and fossil caps, however, seem to be lacking in these types of stylolites.

Theoretically, Rothpletz's explanation sounds plausible. However, field observations furnish an abundance of evidence against it. This has been conclusively shown by Reis and Wagner, and is discussed later in this paper. Were one to accept his assumption that "stylolites give no indications pointing in any way to any essential chemical activity" his theory would stand with less objection. His statement that oblique and horizontal stylolites bear no clay caps is also at fault.

**SOLUTION THEORY.** The solution theory was first suggested by Fuchs (1894, pp. 673-688). It was more thoroly established by Reis, 1901-1902, and extensively reviewed and studied by Wagner, in 1913.

*Investigations of Fuchs.* After a careful study of stylolites, Fuchs came to the conclusion that (1) they are formed in hard rock by chemical solution, under pressure, along a crack or crevice; the differential ability of the rock to resist solution accounting for the interteething of the strata along the line of solution; (2) the clay cap is the non-soluble residue of the dissolved rock substance; (3) the polished and striated sides of the columns are a result of the movement which has taken place.

The first part of Fuchs' paper is devoted to a discussion of the pressure theory and the experiment of Gumbel (see p. 27). The most important conclusions from Fuchs' investigations may be summarized as follows:

1. Stylolites never appear singly, but always occur collectively, running in lines, forming the so-called "Stylolithenbänder".

2. Contrary to the former assumption that stylolites depend upon planes of stratification (all theories which were formerly postulated proceeded from this supposition which



was regarded, to a certain extent, as self-evident), it is found that stylolites are not confined to stratification planes, but are nothing more than a "highly modified form of crevice". Fuchs came to this conclusion after having observed stylolites which ran obliquely, and even horizontally, and stylolite-lines which even crossed one another at right angles.

3. Stylolites are not formed in soft, plastic sediment, but in already hardened stone.

4. The so-called "Drucksuturen", described by Rothpletz, are similar in all fundamental points to stylolite-seams and are only a special form of them.

5. If the limestone is fossiliferous, one can notice that fossils which border on to "Drucksuturen" appear broken off from them; and on the other side of the suture one will find no continuation. These missing portions of fossils have been actually removed by solution.

6. The clay coverings of the columns consist of the residue of the dissolved substance. The formation of the striated surfaces has resulted from the movement which has taken place.

7. From the study of the analogous phenomenon of "Gerölleindrücke", it appears that a

chemical solution process, which wears away the contact surfaces of certain substances, attacks only the one side and leaves the other apparently untouched.

8. In explaining the changing of a straight, smooth crevice into a jagged, intertoothed suture, by chemical solution, one should picture a crevice in a rock stratum, with the rock substance on each side divided into a number of parts; and assume that along this line one part above will be attacked at one place, and at another place, a part below will be attacked. Noticeable interteething must then take place, and a stylolite-band will result.

*Investigations of Reis.* In addition to corroborating the evidence given by Fuchs, Reis (1901, p. 62; 1902, p. 157), after an investigation of the stylolites of the Muschelkalk, contributed the following additional evidence in support of the solution theory:

1. The actual removal of the hard stone, into which the columns of the opposite side have penetrated, is evidenced especially by a study of the fossils and oölites associated with

stylolites. The fact that there occur fossils which have been partially dissolved away, or entirely cut thru by stylolite columns, without any evidence pointing to their having been mechanically disturbed from their original positions, is sufficient proof of this.

2. Horizontal and oblique stylolites possess the same marked characteristics as the common vertical ones; namely the presence of clay caps, and striations on the sides.

3. The clay cap, formed as a residue and coming to rest at the end of the undissolved portion, would serve as a further protection to the unattacked part. This clay cap is always present and should be considered a part of the stylolite. Fossils, which crown the columns as a result of having been more resistant to solution than the opposite rock, often determine the shape of the stylolites.

The work of Reis is considered difficult to understand because of the unusual amount of detail. It is given a partial review by Wagner (1913, pp. 110-111).

*Investigations of Wagner.* The work of Wagner (1913, pp. 101-128) on "Stylolithen und Drucksuturen" is the most exhaustive and conclusive that has been done on the origin of stylolitic phenomena. Wagner's investigations were made, for the most part, in the Muschelkalk. He described and discussed, in detail, numerous complexities of structure; such as horizontal and oblique stylolites; curved stylolites; stylolite-bands crossing one another, even at right angles; and parallel stylolite-bands intersecting, or "boring" into one another. His paper is accompanied by several plates and figures.

After reviewing some of the theories of the origin of stylolites, Wagner took up a critical discussion of the differences between "Drucksuturen" and "Stylolithen" and arrived at the conclusion that the primary distinction between the phenomena is only a matter of size and form; that no sharp distinction can be made between the two, since all sorts of transition forms are found; that typically jagged lines of the "Drucksuturen" variety grade into typical stylolite-seams. Various transition forms have been described by Freiesleben, Klöden, Quenstedt, Hall, Suess, Fuchs, Reis, and Bittner. Rothpletz described only the extreme forms and thus arrived at his conclusion that they were of different origin.

In support of the solution theory, Wagner corroborated

the points presented by Fuchs and Reis, and gave an abundance of additional evidence. He stated that the strength of the solution theory lies in the unmistakable evidence of the actual removal (not compression) of the material of the one part, which has been penetrated by the column of the opposite part. Wagner's most important contribution to the solution theory was in presenting evidence obtained from a study of fossils associated with stylolites. Especially numerous in the Upper Muschelkalk at Ottendorf were examples found where stylolites had penetrated, and had even completely pierced, mussel shells (see Fig. 29). There was no evidence of mechanical disturbance of the fossils. The absent materials, Wagner pointed out, had been actually removed by chemical solution.

Wagner emphasized the view that the principles of Henry and Rieke—that at the places of strongest pressure greatest solution occurs—are primary considerations in the physico-chemical basis of the solution theory.

Additional important evidence given by Wagner will be presented later in this paper. Wagner summarized his conclusions as follows (Wagner, 1913, p. 126) :

1. The pressure theory is not experimentally confirmed. The experiment of Gümbel involved conditions which are not found in nature.

2. "Stylolithen", "Drucksuturen", and "Gerölleindrücke" occur as a result of chemical solution, under pressure, in hard rock. The differing resistance to chemical solution, of different portions of the rock, accounts for the interteething of the parts.

3. From the principles of Henry and Rieke it follows that in places of strongest pressure, greatest solution takes place; that in places of lessened pressure, on the contrary, even a pause in solution can set in. The solution zone is, for that reason, continually at right angles to the direction of pressure, and is therefore over the ends of the stylolites. The side-surfaces remain unattacked because of being parallel to the direction of pressure, and become smoothed and striated thru movement.

4. The clay cap is the solution residue of the rock mass.

5. Fossils may crown the stylolites. They always show traces of corrosion. They even show interpenetrated, small

stylolites. Mussel and brachiopod shells, and oölitic grains show all stages of solution.

6. Above the stylolite-seam, and parallel with it, the rock is in an entirely undisturbed stratified position.

7. Younger stylolites penetrate thru older ones and may even eradicate them. Bent, or curved, stylolites often occur. Horizontal stylolites show no essential differences from vertical ones.

8. Single stylolites are not found.

9. The size and form of stylolites depends upon the nature of the rock.

10. Direct connection between stylolites and disturbed strata is observed.

11. "Drucksuturen" are young stylolites, or are stylolites forming under changing irregular pressure. Both are forming and "growing" today in rock strata.

12. For the pressure theory of Quenstedt, Gümbel, and Rothpletz, there appears scarcely any proof. In most cases the evidence is directly opposite. The solution theory of Fuchs, which Reis elaborates, always gives a satisfactory explanation. It is experimentally confirmed.

*Other Investigations.* The first to suggest that stylolites may have formed in hardened rock was Cotta, in 1851. However, until Fuchs advanced his theory, it was generally accepted that they originated while the rock was in a plastic state. Bittner, in 1901, came to the conclusion, as did Fuchs and Reis, that the sharp distinction between stylolites and "Drucksuturen", which Rothpletz made, was a faulty one.

Grabau (1913, pp. 786-788) accepted the solution theory as the most satisfactory, stating that

ordinary pressure work has, however, not taken place here, for nowhere is there any evidence of deformation of the beds by crowding or compression above the columns, which project from one face of the suture into the hollows of the other.

Another recent investigator to suggest the solution theory as the one most plausible is Gordon (1918, Jour. Geol., pp. 561-569), who concluded that

from a study of the hundreds of examples in the Tennessee marble, the writer is convinced that in the main they represent fracture planes. Convincing proof of this appears in their irregularity and frequent tendency to cut across the sedimentation planes obliquely or even at



right angles. Wagner, who described them as occurring along fractures, stresses this point when he says that, whereas under the pressure theory the sutures must follow the planes of stratification, in the solution theory they may intersect the stone in any direction.

*Conclusions.* Altho the various theories of the origin of stylolites have had a scattered following among scientists in the past, no one theory has received definite acceptance because of insufficient proof. Conclusive evidence in support of the solution theory was revealed by the writer's field investigation of stylolites. Not only were the observations and conclusions of Fuchs, Reis, and Wagner corroborated, for the most part, but an abundance of new and further convincing evidence was obtained. The writer presents an explanation of stylolites by the solution theory, and the complete evidence in support of it, in the following chapter (see p. 46).

### Part III. A Study of the Stylolites of the Indiana Limestones and the Conclusive Evidence of Their Origin by Chemical Solution

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THE field investigations of the writer have been confined, for the most part, to the rocks of southern Indiana. A few observations, however, have been made also in the Niagaran and Onondaga limestones of New York, in the Monroe and Columbus limestones of Ohio, and in the Tennessee marbles.

#### GEOLOGIC DISTRIBUTION OF STYLOLITES IN INDIANA

In Indiana, the stylolites of special significance are found in the thick Middle Mississippian limestones of three ages: namely, the Harrodsburg, Salem (otherwise known as the Spergen, and commercially known as the Bedford, or Indiana Oölitic), and Mitchell. Brief descriptions of these three formations follow:

##### Harrodsburg Limestone

This is the lowest of the three above-mentioned formations and lies between the Knobstone (a series of alternating arenaceous shales, and sandstones) below, and the Salem limestone above. The formation varies in thickness from 60 to 90 feet. It is generally impure; and in places, is dolomitic. In its lower part, it is a very coarse crinoidal limestone; near the central part, it becomes finer. Here the crinoids, large brachiopods, and pelecypods are replaced principally by bryozoans. Near the top, the limestone assumes very much the character of the overlying Salem.<sup>1</sup>

##### Salem Limestone

No limestone in the United States is better known nor more valuable for ornamental and building purposes than the Salem limestone.<sup>2</sup> It occurs in massive beds varying in thick-

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<sup>1</sup> For a complete description of the Harrodsburg limestone, reference should be made to: Beede, J.W., 1915, pp. 194-203.

<sup>2</sup> For the latest full discussion of the Salem limestone, reference should be made to: Blatchley, R.S., 1908, pp. 299-460.

ness from 25 to nearly 100 feet. It is a granular limestone in which both the grains and cement are carbonate of lime. The grains are made up, for the most part, of Foraminifera, Ostracoda, and bryozoan remains, mingled with fragments of other forms, some of which have not been identified. The texture of the stone varies in coarseness in different localities. The great mass of the stone, however, is made up of the millions of minute, in places almost microscopic, shells which are fairly uniform in size; but in some localities the coarse stone is abundant, as a result of the predominance of many larger shells, such as gastropods and brachiopods. This latter variety of stone is less valuable from the commercial point of view.

The Salem limestone is quite massive, showing very few bedding planes. Cross-bedded lamination is a frequent feature. The formation, in most places, carries two systems of vertical joints, running approximately at right angles with each other. The joints are rarely abundant, generally 20 to 40 feet apart.

The variety in color of the Salem limestone proves to be a feature of considerable importance in the investigation of the origin of stylolites. The stone is of two shades of color, known commercially as "buff" and "blue". (The blue variety is more of a gray, and in places is so light that it is almost white.) The difference in the color of the stone is claimed to be the result of a chemical change in the small amount of iron compounds present, and an oxidation of the carbon content. Originally all of the stone was blue and the iron present was in the form of ferrous compounds. The oxidation of the iron into ferric compounds resulted in the original blue shade being turned into a light brown, giving a buff color to the stone. According to Hopkins (Hopkins and Siebenthal, 1897, p. 309; 1908, p. 314)

The oxidation is a continuous process, not yet complete, carried on mainly by the oxygen in solution in the meteoric water, the circulation of which is accelerated or retarded by a variety of causes.

The line of separation of the buff and blue stone is usually very irregular. Consequently, there are blocks quarried in which both colors are present.<sup>3</sup>

<sup>3</sup> For a full discussion of the color of the Salem limestone, reference should be made to: Mance, G.C., 1917, p. 117; Hopkins, T.C. and Siebenthal, C.E., 1897, pp. 309-310; 1908, pp. 314-316.

The Salem limestone is especially pure, the percentage of calcium carbonate running very high—from 92 to 98 per cent, usually above 95 per cent. The percentage of insoluble constituents, organic matter, silicates, etc., is very low. The percentage of magnesium carbonate, when present, is always very low. A general conception of the composition of the Salem limestone can be gained from the following analysis of a sample taken from the quarry of the Perry Stone Company, Ellettsville district, Monroe County:

Calcium carbonate ( $\text{CaCO}_3$ )	97.27 per cent
Magnesium carbonate ( $\text{MgCO}_3$ )	.89
Alumina ( $\text{Al}_2\text{O}_3$ )	.33
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	.59
Silica ( $\text{SiO}_2$ )	1.00
	<hr/>
	100.08

(Analysis made by Illinois Steel Co.)<sup>4</sup>

The quarrying of the Salem limestone in Indiana is confined mainly to two counties, Monroe and Lawrence. These two counties are conveniently divided into the following quarrying districts:<sup>5</sup>

Monroe County—

- a. Stinesville district.
- b. Ellettsville district.
- c. Hunter Valley district.
- d. Bloomington district.
- e. Sanders district.
- f. Belt district, between Clear Creek and Harrodsburg.

Lawrence County—

- a. Peerless district.
- b. Buff Ridge district.
- c. Reed Station district.
- d. Dark Hollow district.
- e. Bedford and vicinity.

### Mitchell Limestone

Overlying the Salem limestone is a series of limestones of varying texture, appearance, and geologic age, called the Mitchell. In thickness it varies from 200 to 400 feet. Difficulty is found in separating the lithologic formation into its

<sup>4</sup> For tables of chemical analyses of the Salem limestone, reference should be made to: Blatchley, R.S., 1908, pp. 315, 329, 358, 366, 376, 382, 415.

<sup>5</sup> For the latest detailed description and maps of the quarrying districts, reference should be made to: Blatchley, R.S., 1908, pp. 356-451.



integral parts. The texture of the stone varies from the exceedingly fine-grained lithographic form, thru a typical oölite, to brecciated limestone, ending with an edgewise conglomerate. Thin shale and sandstone partings are to be found.<sup>6</sup>

## GENERAL DESCRIPTION OF INDIANA STYLOLITES

The Indiana limestones afford abundant opportunity for a study of stylolites and stylolite-seams of various sizes, types, and complexities. The largest stylolites observed by the writer are 13 inches in length (see Fig. 12) ; some are so small as to be seen distinctly only under a hand-lens. The length of the seams is in proportion to the size of the stylolites—the larger stylolites constituting partings of greater extent than small stylolites. All stylolite-seams, instead of ending abruptly, grade into smaller and smaller sutures, and finally disappear as a barely noticeable line.

In what might be called the most perfect, but not the most common stylolite-seams, the interlocked parts are more or less columnar in shape, the downward and upward projections alternately interpenetrating with much regularity. The assumption, suggested by Marsh, Gümbel, and Rothpletz—that few stylolites extend from the upper layer into the lower—will not hold for the Indiana limestones. If one considers the upward-penetrating columns as stylolites, then the adjacent downward-pointing parts must be considered as reciprocal stylolites. In the larger sutures are often found these most perfectly column-shaped stylolites. They are especially sharply defined in the Salem limestone of the Dark Hollow district (see Figs. 2 and 11). The side-surfaces are often parallel; are always well striated, often having a polished or slickensided appearance, especially if there is a thin deposit of calcite on them; and are often covered with a very thin coating of clay, drawn from the clay cap to the base of the column. The ends of these columns are convex, fitting closely into the concave openings of the penetrated rock, and separated from them by the caps of clay.

Many common variations from this above-described, ideal type of stylolite are found. In their more common and typical development, the interpenetrating parts occur with less regu-

<sup>6</sup> For a description of the Mitchell limestone, reference should be made to: Beede, J.W., 1915, pp. 206-212.

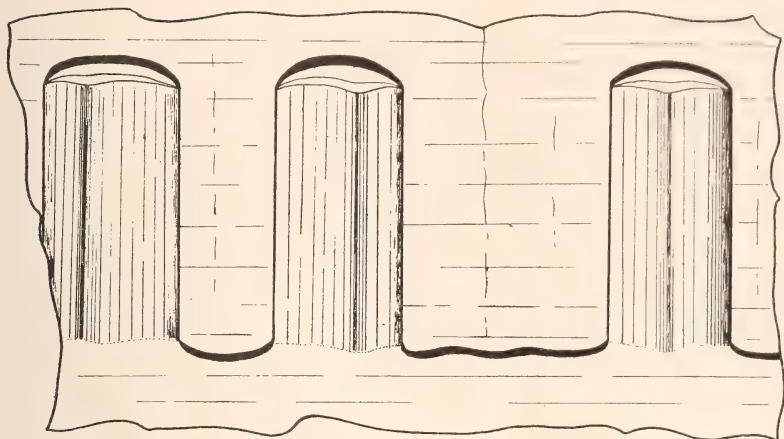


FIG. 11.—Diagrammatic sketch of the large, perfectly formed stylolites of the Salem limestone, such as are found in the Dark Hollow district, Lawrence County, Ind. In this specimen the block has been broken along the side-surfaces of the upward-penetrating columns, showing the striations; and thru the downward-pointing columns, exposing the lamination and texture of the rock. One-fourth natural size.

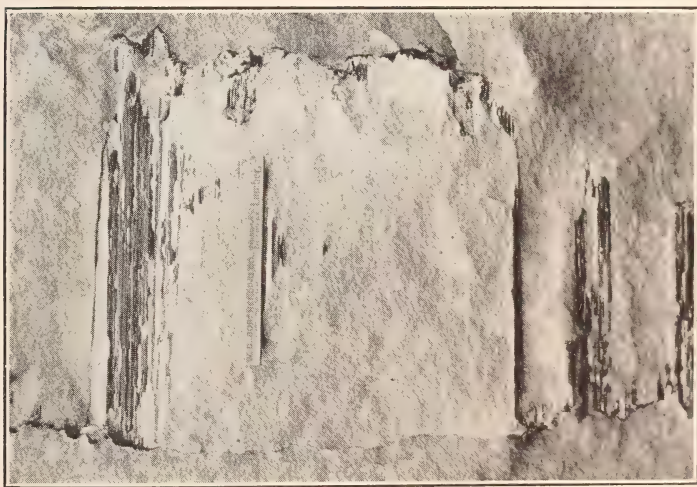


FIG. 12.—Thirteen-inch stylolite in the buff Salem limestone. From a quarry of the Consolidated Stone Company, Dark Hollow district, Lawrence County, Ind.

larity, are more or less irregular in shape and size, and present an extremely jagged suture (see Figs. 3, 13, 14, and 15). The parting is often just an undulating seam with only occasional interpenetrating perfect columns. A few extensive partings, with only a slight stylolitic structure, are to be found. The length and shape of the penetrations are quite variable. Short columns, between longer ones, are frequent. Some columns are very broad, compared with their length, and have flat or undulating ends. The ends of others show a subordinate interpenetration of minor columns (see Fig. 24). The sides of the interpenetrating parts, instead of being parallel, frequently converge towards the end, sometimes coming to a sharp point. This is especially true of smaller penetrations. Along a fractured surface of a block of stone, the jaggedness of the stylolite-seams is often exaggerated because of the irregularity of the fracture (see Fig. 12). The true seam is to be seen on the face of a sawed block which has been cut parallel to the direction of the penetrating parts (see Fig. 15). Stylolite-surfaces, which have been exposed by the splitting of the strata along the suture, present a dark, irregular, pinnacled appearance (see Figs. 4, 5, and 6). The dark color is a result of the clay deposit.

In addition to the larger types of stylolite-partings, hundreds of small, sharply intertoothed sutures are found. They are sometimes so small as to present a barely noticeable line (see Fig. 16). These correspond to the so-called "Druck-suturen" of the German investigators. That no distinction can be made between these and the larger stylolite-partings is unquestionable, since the latter always grade into this small type of seam, and finally disappear as a barely noticeable crevice. These small sutures have all of the fundamental characteristics of the larger ones. The interpenetrating parts are irregular and are usually more or less conically pointed. In some, however, the penetrations are minutely columnar in shape and occur with marked regularity. These are especially noticeable in a fairly fine, even-grained limestone. Occasionally are found two or three closely parallel small partings which abruptly join and continue as one larger seam (see Figs. 16 and 35), the combined amount of penetration of the smaller seams being equivalent to that of the larger one.

Regardless of the size and the character of the stylolite-seam, the striated sides of the penetrations and the clay part-

ing are ever-present features. The clay comes to rest as a thin cap at the end of the columns. Its thickness is as variable as the size of the stylolite. In the smallest sutures, the clay

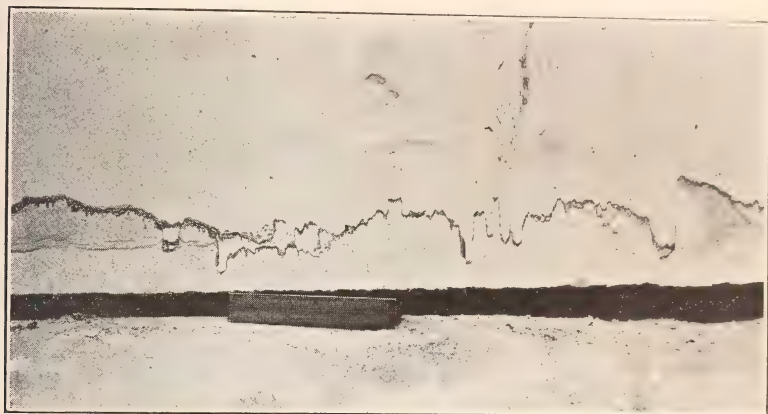


FIG. 13.—Complex stylolite-seam of the Salem limestone. From a quarry of W. McMillan and Son, Peerless district, Lawrence County, Ind.



FIG. 14.—Diagram of a small, jagged stylolite-seam of the lower Harrodsburg limestone. Note the variety of shapes of the interpenetrating parts. Natural size.

is only microscopically visible, but, nevertheless, is present. In the largest sutures, it is sometimes as much as an inch in thickness. Shorter stylolites between longer ones bear caps



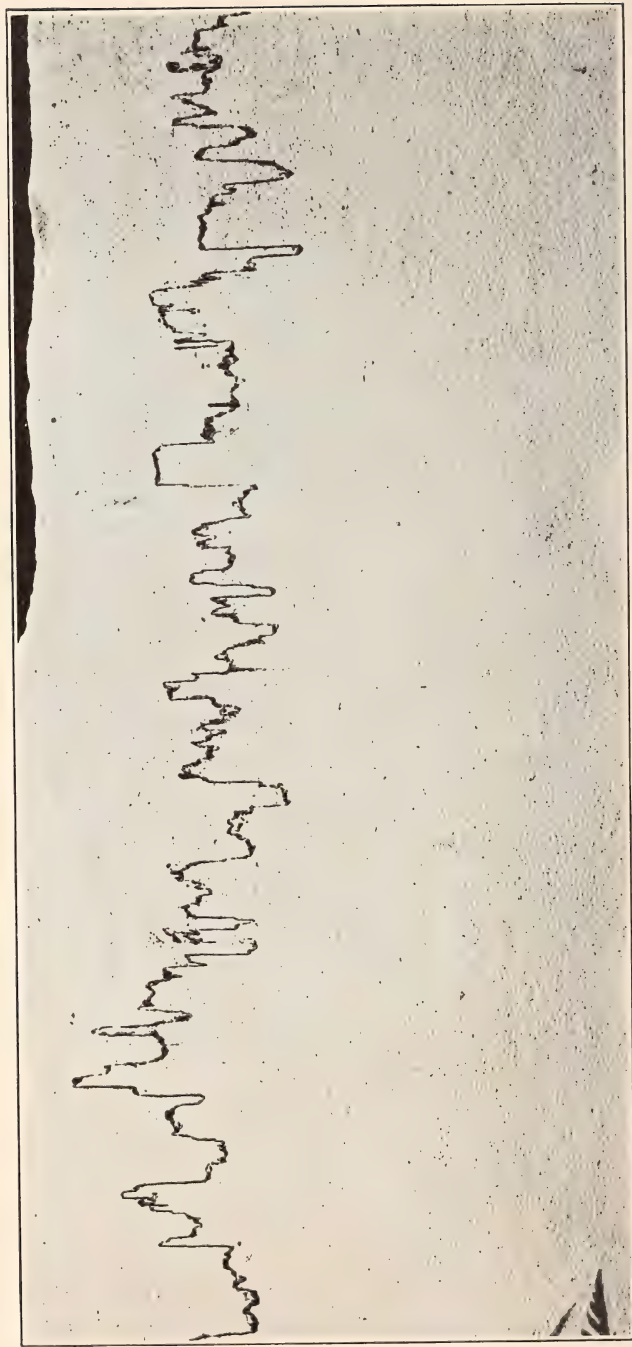


FIG. 15.—Typical stylolite-seam as it appears on a sawed surface of the Salem limestone. Note the irregularity in size and shape of the interpenetrating parts. About one-half natural size.

of the same thickness as the adjacent longer ones (see Fig. 26). A very thin coating of clay covers the striated side-surfaces of the penetrations, and diminishes in thickness from the end to the base. The color of the clay varies with the color of the stone. Stylolites of the "buff" stone bear brown caps; those of the "blue" stone, black caps. Gradations between these are also found. The clay caps often present a compact, laminated appearance. Their line of contact with the end of the column is usually sharp, altho in some instances, the caps appear to grade slightly into the limestone of the column.

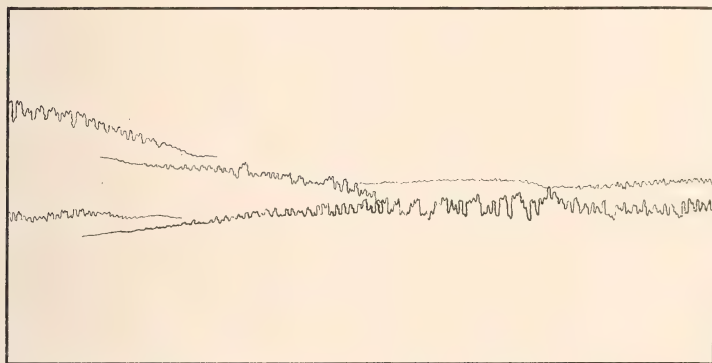


FIG. 16.—Diagram of the small, finely toothed type of stylolite-seams. The sutures end in a fine, barely noticeable line. Note the resemblance to the sutures of the human skull. Such a seam represents the "Drucksuturen" of the German investigators. This specimen is from the Mitchell limestone. Three-fourths natural size.

Distinct fossils are lacking in the clay, altho corroded fragments are often found. Chemical analyses of the clay caps show them to be similar to the residual clays of limestones (see pp. 67-83).

### Relation to Stratification

The stylolite-seams of the Harrodsburg, Salem, and Mitchell limestones of Indiana are, in general, horizontal, and parallel with the lines of stratification, usually running along the bedding planes or lamination of the rock. The larger stylolite-seams, especially, often mark stratification planes; and are traceable, with no sharp break, into the common bed-

ding planes having no evidence of stylolites. They are very common at the junction of cross-bedded and horizontally bedded strata in the Salem limestone. They often sharply mark the parting between beds of distinctly different lithologic characteristics. Contrary, however, to the observations of Hopkins (Hopkins and Siebenthal, 1897, p. 307), that they never run across the grain, the writer has observed cases where even large seams leave the bedding planes and cut across the lamination (see Fig. 17). In one instance, an ap-

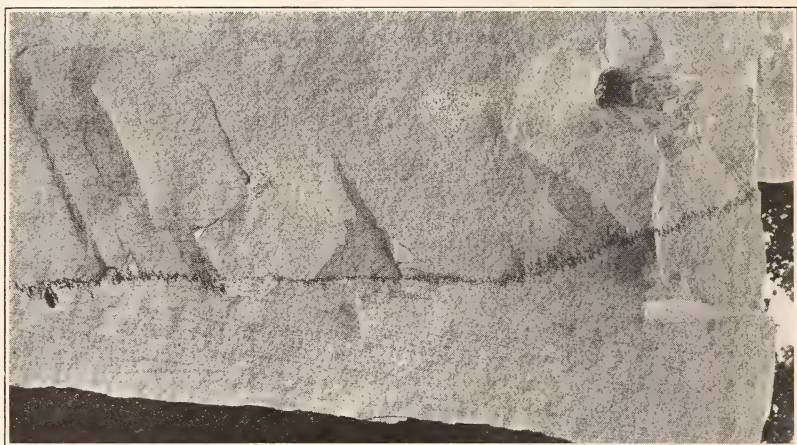


FIG. 17.—Stylolite-seam which leaves the bedding plane and cuts across the lamination of the upper stratum at an angle of about 20 degrees. From a quarry of the Consolidated Stone Company, Hunter Valley district, Monroe County, Ind.

parent fault-surface, cutting the bedding at an angle of about 60°, has developed a slightly stylolitic nature.

The many minute, sharply-toothed sutures, varying from an almost microscopic width up to a fraction of an inch or so, usually follow the lamination, but occasionally cut across the laminae at a small angle (see Fig. 16). Their general direction, however, as in the case of larger stylolite-seams, is horizontal. In some instances they follow the laminae of a false-bedded stratum.

The frequency of occurrence of stylolite-partings is quite variable in different geologic horizons, and in different locali-

ties. The structures are probably most numerous in the semi-lithographic strata of the Mitchell limestone, where several



FIG. 18.—Pile of waste stone, a result, for the most part, of stylolite-seams. The Consolidated Stone Company, Dark Hollow district, Lawrence County, Ind.

small partings occur only a few inches apart. Some of the Salem limestone quarries are almost devoid of the phenomenon; others reveal numerous examples. In some instances,



overlying, parallel seams are so close together as to penetrate, or even partially eradicate, one another (see p. 64).

The stylolite-partings of the Salem limestone attract much popular attention because they necessitate a considerable amount of waste stone which is not generally utilized for commercial purposes (see Fig. 18).

## PHYSICO-CHEMICAL BASIS OF THE SOLUTION THEORY

### Statement of the Theory

That the writer's investigations of stylolitic phenomena revealed conclusive evidence in support of the solution theory, and in direct opposition to the pressure theory, has already been stated. Briefly, the writer wishes to present the theory as follows: Stylolitic phenomena result from the differential chemical solution of hardened rock, under pressure, on the two sides of a bedding plane, lamination plane, or crevice, the undissolved portions of the one side fitting into the dissolved-out parts of the opposite, the interfitting taking place slowly and gradually as solution continues. Stylolites are limited to carbonate rocks. The explanation of their origin is taken up in detail on page 49. A discussion of the solution theory first necessitates the consideration of a few physico-chemical factors.

### Effect of Carbon Dioxide upon Solution

Of the various constituents absorbed by water, which are especially effective in chemical changes in rocks, carbon dioxide is one of the most important. That nearly all minerals are more or less attacked even by pure water, and that their solubility is markedly increased in water containing dissolved carbon dioxide (carbonic acid), are well-known facts which need no further discussion.

### Effect of Pressure upon the Solution of Gases in Liquids

From the law of Henry it follows that increase of pressure upon a liquid increases the weight of gas going into solution, the increase being proportional to the amount of pressure. Thus, an increase in pressure results in a proportional increase in the amount of carbon dioxide which water dissolves, which in turn increases the dissolving strength of carbonic acid upon the minerals attacked.

## **Effect of Temperature upon the Solution of Solids in Liquids**

Altho the solvent action of water, especially if charged with carbon dioxide, is marked at ordinary or even low temperatures, there is no doubt that the action is increased by heat. That, as a rule, solids are more soluble in warm than in cold solvents is an established fact.

## **Effect of Pressure upon the Solution of Solids in Liquids**

That the effect of pressure must be recognized as important in increasing the solubility of certain solids in liquids, is a factor of special significance in considering the origin of stylolites. From this principle it follows that, at the places of increased pressure, increased solution takes place. Van Hise states that

In the common case in which the volume of the solution is less than that of the solvent and solid, pressure increases solubility; for in that case solution tends to bring the molecules together and works in conjunction with the pressure. . . . It is well known that the solubility of calcium carbonate is increased by pressure (Van Hise, 1904, pp. 77-78).

This principle has also been recognized and emphasized by Geikie (1903, pp. 411, 419). It has been thoroly established by E. Rieke, Sorby, and others, and experimentally confirmed by F. Becke and Daubrée. Upon this principle is based the theory of the origin of the solution type of impressions in pebbles (see p. 18). Here is a case of a mass of pebbles in a conglomerate where, of course, the pressure exerted upon each other is at the point of contact, and where the solution of the one takes place at the point of contact with the other.

## **Result of Supersaturation of a Solution**

Since increased pressure or temperature, or both, may result in a supernormal amount of a solid being dissolved by a solvent, a decrease in the pressure or temperature may give rise to a supersaturated solution, and a consequent crystallizing out of the excess solute. Release of pressure gives a similar result in the solution of gases in liquids. For example, water under pressure is capable of dissolving an excess of carbon dioxide, and consequently of carrying an excess of mineral matter in solution. Release of pressure upon the solvent effects an escape of some of the carbon dioxide and a

precipitation of the excess mineral matter which can no longer be held in solution because of the weakening of the carbonic acid.

### Solubility of Limestone

It is well established that calcium carbonate is nearly insoluble in pure water, but that it is readily attacked by carbonic acid ( $\text{H}_2\text{CO}_3$ ) and converted into calcium bicarbonate,  $\text{H}_2\text{Ca}(\text{CO}_3)_2$ , which is quite soluble in water. Thus, since limestone is made up, for the most part, of calcium carbonate, it may be almost entirely removed by solution, leaving a residual



FIG. 19.—Limestone boulder channeled by water containing carbon dioxide, illustrating the occurrence of differential solution similar to that required in the development of stylolitic phenomena. (From Cleland's Geology.)

clay composed of the less soluble, minor constituents of the rock—principally silica, alumina, oxides of iron, with small quantities of soda, potash, magnesium carbonate, and calcium carbonate which have not been completely dissolved. In the case of limestone, instead of there being a gradual transition from fully-formed residual clay into the parent rock, the passage from the clay to bed rock is sudden. The reason is that the clay is left as a residue from solution, and not from a gradual chemical breaking down and change of the minerals of the rock, as in the case of granites, etc. Thus a small thick-

ness of residual limestone clay is a product of the solution of a much greater thickness of parent rock, the proportion depending upon the purity of the limestone.

The differential weathering of limestone is often quite striking. Since the ability of limestone to resist solution is quite variable, even thruout a single stratum, a solution surface often presents an undulating and irregular appearance (see Fig. 19).

## EXPLANATION OF STYLOLITIC PHENOMENA UNDER THE SOLUTION THEORY

Of the above-discussed factors, the writer wishes to emphasize the following two as the most important in the explanation of stylolites:

1. The effect of pressure upon the solution of solids.
2. The differential solubility of limestones, and other carbonate rocks.

Stylolites originate in carbonate rocks—varieties of limestones, dolomites, and marbles—along a bedding plane, lamination plane, or crevice, where the circulation of ground waters, charged with carbon dioxide, is most free. Here, then, solution begins. If the ability of the rock to resist solution is slightly variable on one side of the crevice or the other, the carbonic acid would, of course, attack the less resistant parts. If these more soluble portions are distributed first on one side of the crevice, and then on the other, a slightly undulating line would develop, with the undulations becoming more marked after further solution, the outstanding resistant parts of the one side fitting into the dissolved-out portions of the opposite. After the development of this undulating line, pressure (in most cases static pressure, resulting from the weight of the superincumbent strata) plays its rôle. Most of the weight of the overlying sediment is concentrated along the axis (the top and bottom surfaces) of each of these undulations. This results in an increased amount of solution at the points of increased pressure. The sloping sides of the undulations, which are freer from pressure than the tops and bottoms, are proportionately less attacked by the solvent. Increased solution of the weaker rock opposite the ends of the undulations results in (*a*) a



deepening of the interpenetrating parts, (b) a decrease in the pressure and consequent decrease in the solution of the sides of the undulations, and (c) a final development of vertical columns, with practically a complete concentration of the pressure and consequent solution at the ends. The sides of the columns, being free from pressure, usually are unattacked by solution. Continued solution at the ends results in a further deepening and lengthening of the interpenetrating columns. Striation of the side-surfaces results from the slow movement of the columns past one another. The non-soluble constituents of the dissolved rock come to rest as a clay residue at the end of each column, and serve as a further protection from solution of the resistant part. Increase in the length of the stylolites results in a proportional thickening of the residual clay. The length of the columns serves as a fair measure of the amount of solution which has taken place, providing the ends of the columns themselves have not been subjected to solution. On the sides of the stylolites, which are free from pressure and practically unattacked by solution, are often found deposits of mineral matter precipitated there from the supersaturated solvent resulting from the increased pressure and amount of solution opposite the ends. Such coatings of mineral matter are often slickensided as a result of further growth and interpenetration of the columns. The length of the stylolites depends upon three principal factors: (a) the length of time solution has gone on, (b) the solubility of the stone, and (c) whether or not solution has attacked the ends of the stylolites.

Thus it is seen that the principal factors in the development of stylolites are: (a) the presence of a crevice in the rock which permits a concentration of carbonated water; (b) the fact that carbonate rocks (limestones, dolomites, and marbles) exhibit a differential solubility; and (c) the physico-chemical principle that an increase in pressure effects an increase in the solubility of a solid, as shown by Rieke, Sorby, Geikie, Van Hise, and others, and experimentally confirmed by Becke and Daubrée.

Wagner (1913, pp. 122-123) stressed the point, from the law of Henry, that an increase in pressure upon the solvent at the ends of the columns would permit an increase in the amount of carbon dioxide dissolved, which in turn would increase the amount of solution at these places. Reis pointed

out that slight tremblings within the rock might cause friction, thus creating heat, which in turn would increase the dissolving powers of the solvents. The writer believes this latter conclusion to be unimportant in explaining the development of such an intertoothed phenomenon as stylolites.

From the solution theory it can be seen that a vast number of variations in size, shape, distribution, and character of stylolites is to be expected, principally from (a) variations in the composition and lithologic nature of the rock, (b) the erratic distribution of varying soluble portions of the stone, (c) variations in the direction of pressure exerted upon the rock, and (d) the length of time solution has continued.

The spacing of the alternating, less resistant portions of the stone on the two sides of the crevice may occasionally be quite regular. This, however, would be an exception. In most cases the distribution would be very erratic, so that the resulting columns would be of varying widths. In the beginning, stylolite-seams are the small, finely serrated type. A little further solution might, because of differential solubility of the rock on opposite sides, develop a slightly undulating stylolite-seam, each of these undulations bearing smaller penetrations in varying numbers. A continuation of the process upon these compound major undulations might result in the development of larger, major columns, whose ends might be marked with the smaller, original penetrations, such as are often observed (see Fig. 24), and still further continuation of solution might bring about a complete, or almost complete, eradication of these original, smaller, intertoothed parts. All sorts of gradations between the beginning, barely noticeable, undulating line, and the large, major stylolite-seams are to be observed in the field.

If, in the gradual interpenetration of the stylolites, the less resistant portion on the one side, which is being dissolved out opposite the end of the column, changes in resistance so that it is as resistant as, or more resistant than, the penetrating part, solution might then take place in the rock on both sides, or change to the end of the column. Such variations in the chemical resistance to solution therefore often produce quite a diversity in the length and shape of the interpenetrating parts (see Figs. 15 and 26). It explains the occurrence of shorter stylolites between longer ones. If the rock on each side of a solution crevice were of uniform re-



FIG. 20.—Undulating solution seam, containing three-eighths of an inch of black residual clay. This seam, within a short distance to both the left and right, becomes highly stylolitic. See Fig. 21. From a quarry of the Consolidated Stone Company, Dark Hollow district, Lawrence County, Ind.

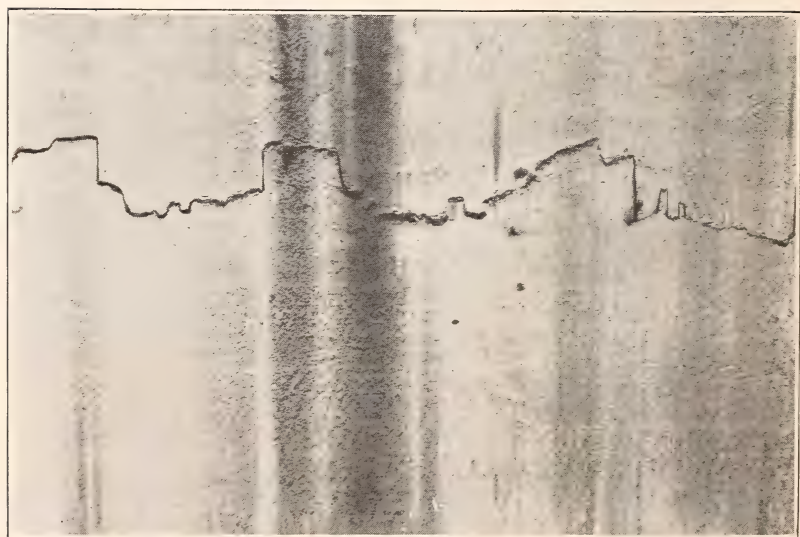


FIG. 21.—Stylolitic portion of the seam shown in Fig. 20.



sistance, stylolitic interteething would not result. Continued solution would give only a slightly undulating seam, with a residual clay parting (see Fig. 20). Such seams are found. They sometimes continue for several yards, with perhaps an occasional, sharply protruding column (perhaps several inches in length), or a series of columns, where the rock offered sufficient differential resistance to solution to produce such (see Fig. 21).

Converging and pointed penetrations might result where the difference in resistance to solution on the two sides of the crevice is little and is less than that in the case of columns with parallel sides. Altho most of the solution is confined to the ends of the columns where the pressure is greatest, the side-surfaces might be more or less attacked. Since the end represents the first and oldest portion of the columns, the portions nearer the end, because of their longer existence, would be longer exposed to the attack of whatever solution might take place on the sides, and would thus become gradually narrowed, giving converging or pointed columns. Dynamic, lateral pressure upon the rock would promote further solution of the sides. Wagner emphasized this point in explaining pointed penetrations.

The writer would explain curved, or bent, stylolites as a result of the columns, during their growth, striking an especially resistant part at an angle (the resistance being sufficient to overcome the effect of the overlying pressure upon vertical solution) and consequently being deflected to one side, following the line of least resistance. The occurrence of such is an exception among Indiana stylolites. The writer observed a few cases where the bending of the column had been sufficient to fracture it. Wagner explained curved stylolites as resulting from "complicated pressure and solution factors" and gave examples where the fractures on the concave sides had been filled with gypsum (Wagner, 1913, p. 118).

With the exception of the few cases of curved stylolites, the direction of penetration is parallel with the direction of pressure, and the plane of solution is usually at right angles to it. In undisturbed strata, void of lateral, dynamic pressure, the pressure is static, resulting from the weight of the overlying sediments; the stylolites are vertical, and the stylolite-seams, horizontal. Such is the usual case in the Indiana



limestones. In strata where folding has occurred, stylolite-seams are sometimes found along the inclined bedding planes with the individual columns themselves vertical instead of at right angles to the bedding planes. Evidently the stylolites developed after the lateral compressive forces ceased, their development being in response merely to the vertical static pressure due to the weight of the superincumbent rock—the inclined bedding plane providing an avenue for ground water circulation. Examples of such are noticeable in the steeply

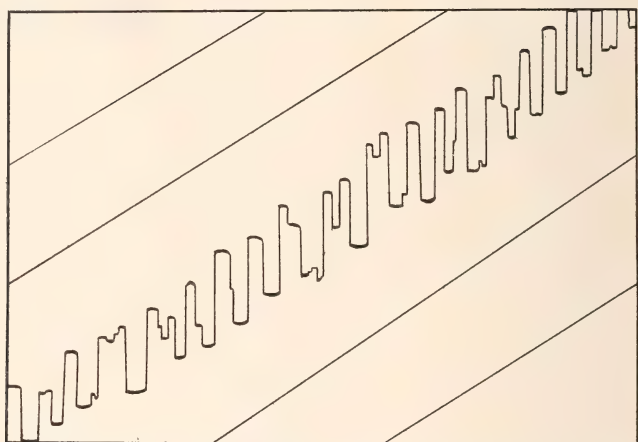


FIG. 22.—Diagram of stylolite-seam along an inclined bedding plane, where the position of the individual columns is vertical, instead of at right angles to the plane of stratification. Observed in the steeply inclined strata of the “Niagara domes” of northern Indiana by Professor E. R. Cumings.

inclined strata of the so-called “Niagara domes” of Northern Indiana (see Fig. 22). Where lateral pressure exists, horizontal and angular columns may develop along vertical and angular crevices, the direction of penetration of the columns depending upon the direction of the pressure. The occurrence of such is described by Fuchs, Reis, Wagner, Gordon, and others.

The above discussion shows that a great number of stylolitic variations and complexities are to be expected, and can be explained by the solution theory. A discussion of the

various phases of the phenomenon which have special bearing upon the solution theory, in opposition to the pressure theory, follows.

## CONCLUSIVE EVIDENCE WHICH ESTABLISHES THE SOLUTION THEORY OF THE ORIGIN OF STYLOLITES, AND OPPOSES THE PRESSURE THEORY

The solution theory and the pressure theory are very strikingly opposed to each other. The first attributes to stylolites an origin in hardened rock; the second, an origin resulting from the differential compression of sediments in the soft, plastic state. Thus, a great amount of the evidence supporting the one theory stands in direct contradiction to the other. With this in view, the writer wishes to present three principal lines of evidence establishing the solution theory; namely: (1) evidence that stylolitic phenomena originate not in plastic rock, but in consolidated, hardened rock, the penetrations of the one stratum fitting into the cavities of the opposite which have been formed by the actual removal (not compression) of rock material; (2) evidence that the clay caps of the penetrations are the solution residue of the dissolved limestone; (3) stratigraphic evidence which precludes the pressure theory and supports the solution theory. The writer believes that proving these points alone is sufficient to establish conclusively the solution theory. However, additional evidence along other lines will also be presented.

### 1. Evidence that Stylolites Originate in Hardened Rock with the Actual Removal of Rock Material

RELATION OF STYLOLITES TO THE LAMINATION OF THE ROCK. The Indiana limestones afford unusual opportunity for a study of the relation of stylolitic structures to sedimentary conditions. Field studies of stylolites reveal the conclusive fact that all penetrations bear the same lithologic characteristics as the strata from which they protrude. Especially striking is this observation where a stylolite-seam occurs along a disconformity or a bedding plane between two distinctly lithologically different strata, such as a coarsely fossiliferous bed and a fine-grained oölitic, or semi-lithographic one, etc. In such cases, adjacent columns exhibit a sharp contrast. This observation is yet more striking where a stylolite-

seam marks the line between a distinctly laminated stratum and one showing little lamination. This is best understood from a study of Fig. 23. Here the horizontal lamination of the upper stratum is distinctly continued into the downward-penetrating columns. The laminae are sharply cut off at the edges of a column, but are continued in the next downward-pointing one. There is no evidence of distortion or disturbance of the lamination, either within the columns, or above them. At the ends of the upward-pointing columns, the laminae, instead of bending around the convex ends, retain

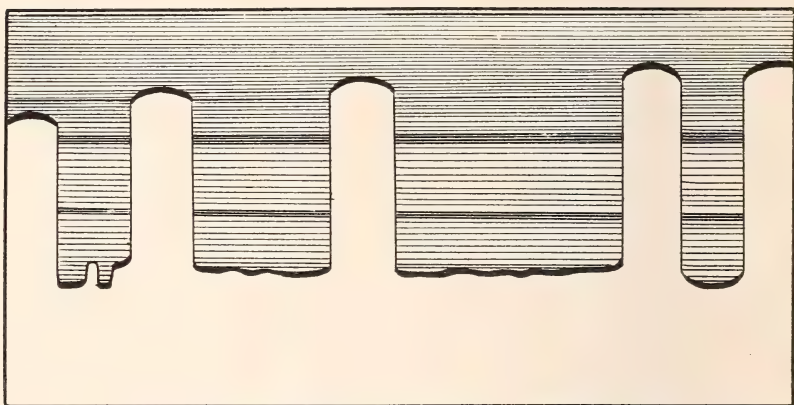


FIG. 23.—Semi-diagrammatic sketch, showing the relation of stylolites to the lamination of the rock. Note that the distinct laminae of the upper layer are undisturbed, both above the upward-penetrating columns, and within the downward-pointing ones. The laminae are not bent around the ends of the columns, but are actually hollowed out. Note the darker laminae.

undisturbed their parallel, horizontal position, the rock having been actually hollowed out.

More striking yet is this observation of undisturbed lamination as seen where a stylolite-parting occurs between a cross-bedded and a horizontally bedded stratum. The most distinct example was observed by the writer at a quarry of J. Hoadley and Sons Co., Stinesville district (see Fig. 24). Here the overlying bed is distinctly cross-bedded, and the lower one clearly horizontally laminated. Very pronounced is the continuation of the angular lamination from the upper

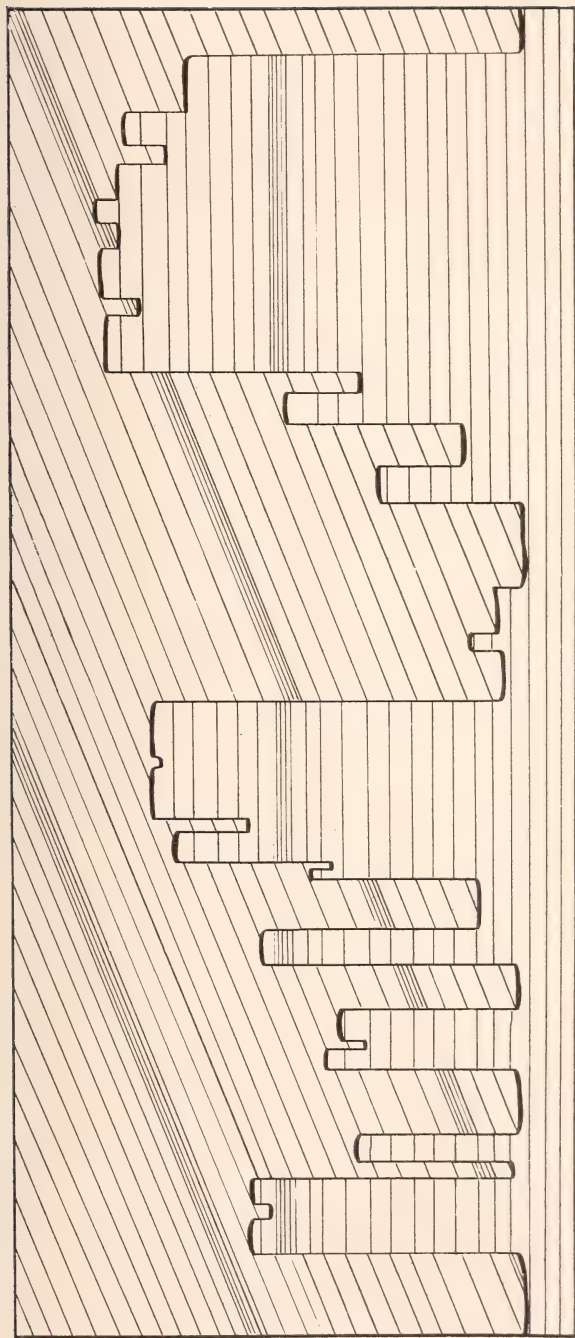


FIG. 24.—Semi-diagrammatic sketch of a stylolite-seam occurring at the junction of a cross-bedded stratum and a horizontally laminated one. Note that the angular lamination of the above layer is continued into the downward-pointing columns, and the horizontal lamination of the lower stratum is continued into the upward-pointing penetrations. Note, also, the presence of smaller inter-toothed columns at the ends of the large, major penetrations. One-fourth natural size. From a quarry of J. Hoadley and Sons, Stinesville district, Monroe County, Ind.



stratum into the downward-pointing penetrations, and the presence of horizontal lamination in the adjacent, upward-projecting columns.

Often dark laminae stand out very clearly in the stratification. Where penetrated by stylolites, they are missing (see Figs. 23 and 24). Under the pressure theory one should expect to find them displaced above or below the ends of the penetrating columns. Such is not the case. How could the various, above-described laminated conditions have been retained, had the sediments been "differentially compressed in a plastic state"? The rock materials have been actually re-

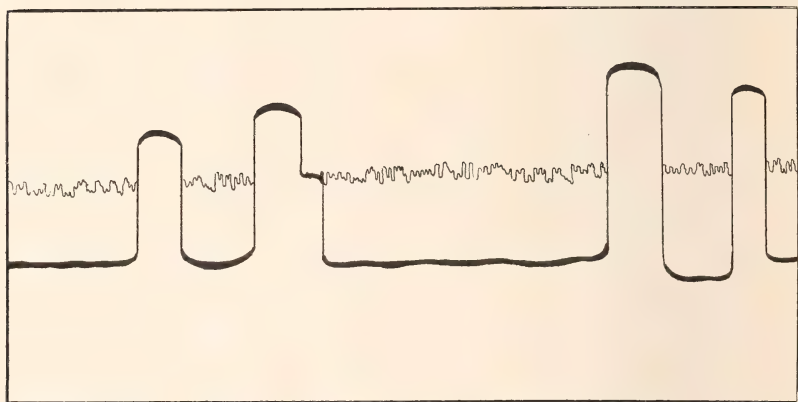


FIG. 25.—Diagram of a small stylolite-seam partially eradicated by the penetration of upward-pointing columns of a large stylolite-seam. Mitchell limestone. One-third natural size.

moved, and the two beds have been "dovetailed" into each other.

Analogous to this observation of the removal of the laminae of the one bed into which the columns of the opposite have penetrated, are numerous examples of small stylolite-seams which have been penetrated and removed by larger stylolites. Figure 25 is a case where a small, once-continuous stylolitic suture, following the lamination of the rock, occurs now only in the downward-projecting columns, being sharply cut off and absent in the rock of the upward-pointing parts. Under the pressure theory, should not one expect to find it displaced in the rock above the columns?

Since the solution theory requires an actual removal of rock material to an amount at least equal to the length of the stylolites—sometimes as much as a foot, which would mean that the rock strata had been reduced in thickness that amount—one might expect a sag of the overlying rock strata towards the center of the stylolite-parting, where solution reaches its maximum. The occurrence of such a sag is rare since stylolite-seams are so numerous and so distributed that the amount of displacement of one seam is compensated by that of an adjacent, underlying one. Such a phenomenon, however, was noticed by the writer, especially in one locality, a quarry of W. McMillan and Son, Reed Station district. Here, the occurrence of stylolite-seams is less common than usual. At the time of the writer's observation, a quarry face exposed an entire stylolite-seam, grading at both ends into a hardly noticeable line, and reaching a maximum thickness of eight inches in the middle. A sag in the seam and the well-laminated bed above it, equivalent to about eight inches (the maximum amount of penetration), was distinctly noticeable.

RELATION OF STYLOLITES TO THE COLOR OF THE ROCK. The difference in color of the Salem limestone presents some peculiarly interesting relationships in the study of stylolites. The sutures are frequently found at the contact of beds of the blue and buff varieties of stone, in which case the columns pointing in one direction will stand out in color contrast with the adjacent ones (see Fig. 26). An interesting case is represented in Fig. 27 in which the blue and buff contact presents quite an irregular outline. Here, the irregular blue parts of the upward-pointing columns are not continued into the adjacent downward-penetrating buff columns. This phenomenon involves a consideration of the origin of the two colors of the stone. If the rock were all originally blue, according to the generally accepted theory, the question arises as to whether or not the irregular color change of the above-figured example took place before, or after, the development of the stylolites. It would appear that the stylolitic development was subsequent to the color change—that the blue parts of the underlying stratum have been actually removed and are now occupied by the downward-projecting buff columns of the overlying layer. If this was the case, the phenomenon furnishes additional evidence that the stylolitic structures



FIG. 26.—A typical, large stylolite-seam in the Salem limestone of the Dark Hollow district, Lawrence County, Ind. Note the irregularity in length and width of the interpenetrating parts. The darker, upper stratum is blue stone; and the lower, buff. Note the small, minor stylolite-seam running across the column below X. The clay parting is plainly visible. The upper and lower strata are distinctly lithologically different. The longest column is about 9 inches.

were formed after the hardening of the rock, since the alteration of the buff stone from the blue is in itself (according to the theory) a feature which occurred since the consolidation of the rock. Observations of the above nature are not uncommon in the Salem limestone. It has been suggested, however, that the above-described color changes of alternating columns could have occurred since the development of the stylolites, altho evidence appears to be against it.

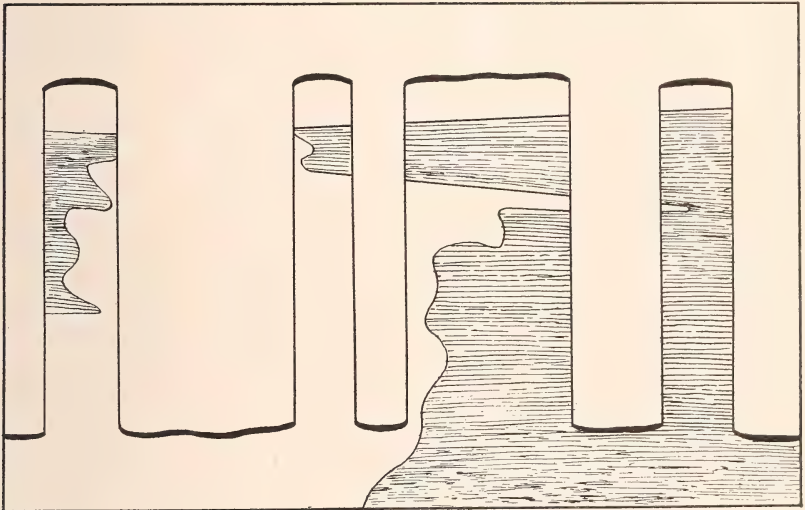


FIG. 27.—Semi-diagrammatic sketch of stylolites in the Salem limestone, showing blue (shaded) portions of the lower stratum penetrated by buff columns of the upper layer. One-third natural size.

RELATION OF STYLOLITES TO FOSSILS. Careful observations of Indiana stylolites show the presence of fossil caps to be an exception. This fact alone precludes Marsh's theory in which the fossil caps were an essential feature. The former assumption that each column has a shell at its end was no doubt a prejudiced one. Stylolitic phenomena are just as numerous in the non-fossiliferous, even lithographic, strata as in the highly fossiliferous ones. Only a few cases have been observed by the writer where the outline of the stylolite was determined by the presence of a fossil covering. Frequently, however, the stylolite ends are partially covered



by a shell. The presence of a shell covering might, no doubt, favor the formation of the columns, the shell often being more resistant to solution than the opposite rock mass. Shell coverings, when present, often show distinct signs of corrosion—a distinct evidence in support of the solution theory. Wagner's investigations of the Muschelkalk stylolites revealed the frequent occurrence of fossil coverings which determined the shape of the columns. The fossils of the Muschelkalk, however, are much larger than those of the Indiana limestones. Wagner treats of the subject in much detail (Wagner, 1913, pp. 119-121).

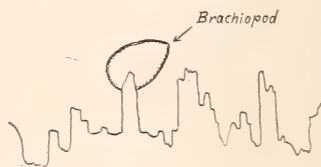


FIG. 28.—Example of a brachiopod shell partially penetrated by a column of a small stylolite-seam. Mitchell limestone. Two times natural size.

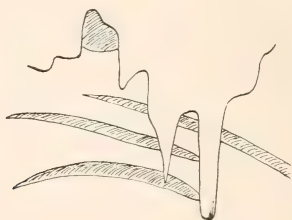


FIG. 29.—Mussel shells pierced by stylolites. (After Wagner.)

The smoothness and sharpness with which the edges of stylolites are cut is striking. Close inspection of the columns shows that the hundreds of fossils, oölitic grains, mineral crystals, etc., have been sharply smoothed off at the contact of the sides of the penetrations. The missing remains are not to be found. The lower, coarsely fossiliferous portion of the Harrodsburg limestone reveals many examples of this, and microscopic examination of the fine-grained Salem limestone gives an abundance of distinct evidence. Above or below the stylolite-seams are often found remains of brachiopods, gastropods, bryozoans, etc., which have been pierced, or

partially penetrated, by small columns (see Figs. 28 and 29). Polished surfaces of the Tennessee marble often offer splendid examples of this (see Fig. 30). Many specimens of fossils which have been penetrated by stylolites are found in the Columbus limestone of Ohio. One of the most striking ex-

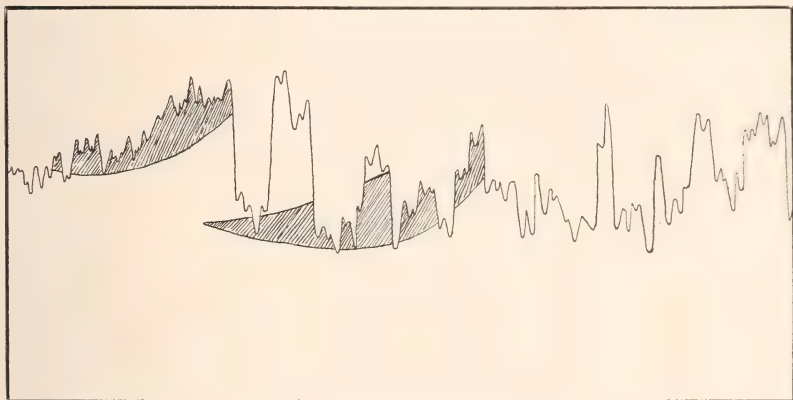


FIG. 30.—Large shells (shaded portions) penetrated by stylolites. Specimen is from a polished slab of Tennessee marble in the Monroe County State Bank, Bloomington, Ind. Three-fourths natural size.

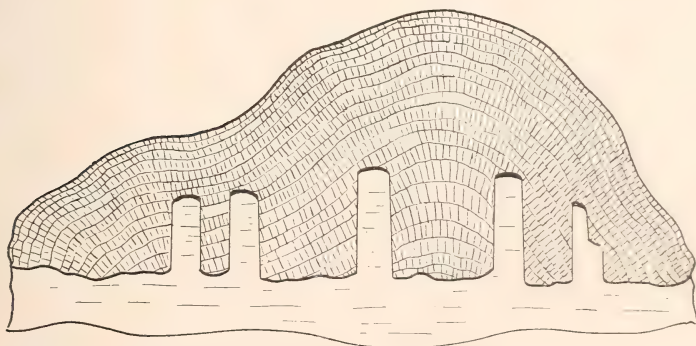


FIG. 31.—Diagram of a stromatoporoid into which a series of stylolites have penetrated. Note that the fossil structure has been actually removed where the upward-pointing columns occur. From a specimen in the Geological Museum, Ohio State University. About one-third natural size.

amples, observed by the writer, is that of a stromatoporoid into which a series of columns of considerable size have penetrated (see Fig. 31). Here is a conclusive case of part of the fossil structure having been actually removed, and occupied by the upward-pointing columns of the rock below. The residual clay is found in its place at the end of the columns.

These numerous, partially cut fossil shells, mineral grains, etc., mentioned above, show no evidence of compression or disturbance from their original positions. They have been cut after the rock material was firmly hardened and cemented together. These observations alone preclude all other theories of the origin of stylolites.

PENETRATION OF ONE STYLOLITE-SEAM BY ANOTHER ADJACENT PARALLEL SEAM. The vertical distance between stylolite-seams is quite variable. It is sometimes as small as a few inches. Sometimes the seams are so close as to touch, penetrate, or pierce one another. In all cases, parallel stylolite-seams, as they grow, become closer together by a distance dependent upon the amount of solution which takes place. Thus, two parallel seams, which in their beginning were separated by a very thin layer, might, after sufficient solution and growth, become so close as to touch one another (see Fig. 32). Continued solution would result in the interpenetration of the two, and still further growth would cause a partial, or complete, eradication of one or the other. These various stages are observed in the Indiana limestones. The above-mentioned Fig. 25 is an example where a large, major stylolite-seam has partially destroyed a small, minor one. Individual stylolite-columns of various sizes, which bear a partially penetrated column of an overlying or underlying seam, have been observed. Wagner (1913, p. 118) cites the example of an older curved stylolite which has been pierced by a younger vertical one (see Fig. 33). All this evidence is decisive proof of the actual removal of rock material, and presents a phase of the problem which can be explained by no other theory than solution.

STRIATED AND SLICKENSIDED FACES OF STYLOLITES. The ever-present striations on the side-surfaces of stylolites, running parallel with the direction of penetration, present a problem hard to explain by the pressure, and other theories.

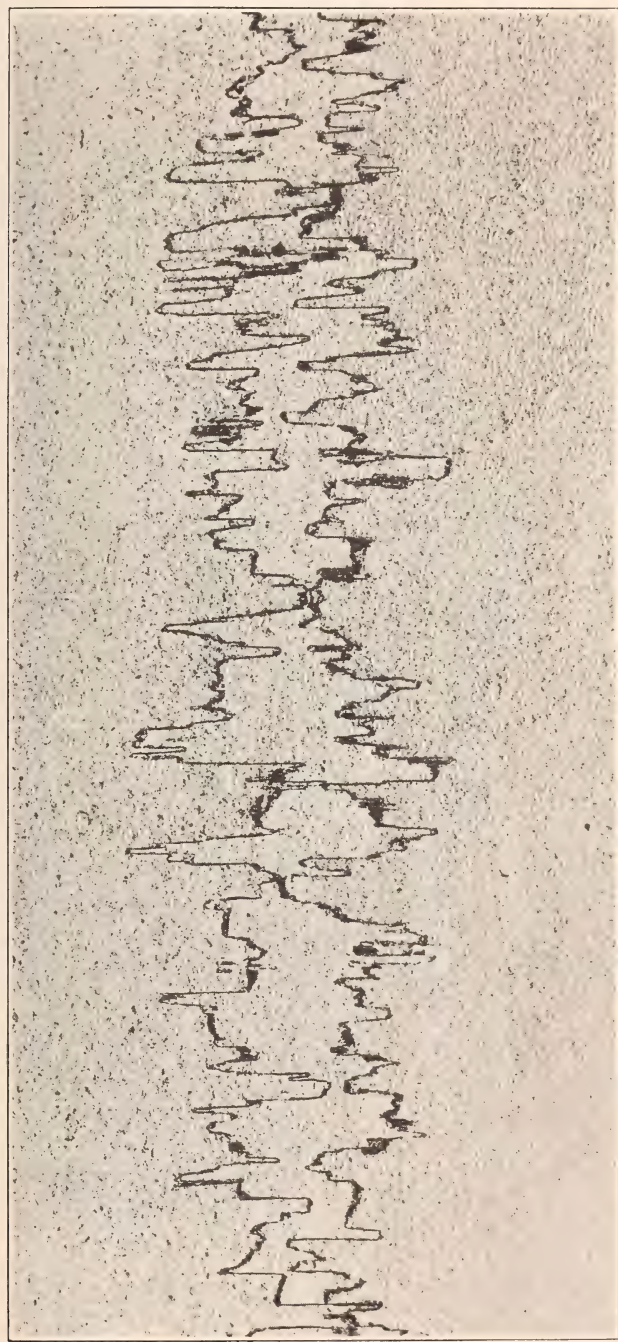


FIG. 32.—Two parallel stylolite-seams of the Salem limestone, which, in places, touch and partially penetrate one another.



Still more difficult to account for by the pressure theory are the numerous polished and slickensided mineral deposits—usually calcite—on the sides of the columns (see pp. 50 and 88). There can be no question but that this mineral matter was deposited there after the rock had become hardened. Further movement of the columns past one another then resulted in the polishing of such deposits. That striations and slickensides were developed while the rock was yet in a soft plastic state appears to be a physical impossibility. They result from the slow slipping of the face of one column along that of the adjacent one, in hardened rock, such as takes place along a fault surface. Striations of stylolites of coarse-grained stone are deeper and coarser than those of finer-grained rock.

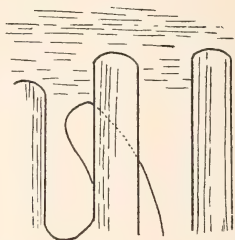


FIG. 33.—Example of an older, curved stylolite pierced by a younger, vertical one. (After Wagner.)

If stylolites were formed in soft, plastic sediment, as explained by the pressure theory, should not one expect the sides of the alternating columns to be intercemented at the time of the hardening and cementation of the entire rock mass? Such is not the case.

**DIRECTION OF STYLOLITES AND STYLOLITE-SEAMS.** The pressure theory would require that stylolite-seams be developed along bedding or lamination planes where a film of clay has been deposited. Differential compression of the plastic, or semi-plastic, mass would thus produce vertical columns at right angles to the bedding planes. However, stylolite-seams are developed along inclined bedding planes with the columns not at right angles to them (see p. 54). Such stylolites have been formed subsequent to the folding and tilting of the strata. Folding obviously either occurred after

the rock had become consolidated, or was responsible for the consolidation. That the pressure theory fails to explain such an occurrence of stylolites is evident.

The pressure theory also fails to explain the origin of stylolite-seams which cut across the stratification at various angles (see Fig. 17). If adherents of the pressure theory would have the seam developed along an angular crevice, it would fall upon them to explain the origin and existence of such a crack in plastic rock. Equally difficult would it be to explain the occurrence of a clay layer along such a crevice (see p. 86).

## **2. Evidence that the Clay Partings Are the Solution Residue of the Dissolved Limestone**

The general assumption of most investigators of stylolitic phenomena, with the exception of the exponents of the solution theory, is that the ever-present clay partings of stylolite-seams represent original, once-continuous, thin layers of clay material laid down in the seas with the lime sediments. The solution theory holds that the clays are the residue of the dissolved rock, altho advocates of the theory, however, have never given conclusive proof of this. The writer wishes to present several lines of evidence showing that the clays are a solution residue.

CHEMICAL RELATIONS BETWEEN THE CLAY CAPS AND THE ASSOCIATED LIMESTONE. No investigator has attempted an analysis of the ever-present clays of stylolites to show the chemical relations between them and the associated limestone (or dolomite or marble). If the clay caps are the solution residue of the dissolved limestone, one should expect a definite relationship between their chemical constituents and those of the limestone from which they were derived. The clay should consist, in the main, of the least soluble components of the parent limestone, with probably a subordinate amount of the soluble substances which have not yet been completely dissolved; since, in the solution of limestone, only the calcium carbonate is removed in appreciable quantities. The clay, if a solution residue, should be nothing more than a concentration of the less soluble constituents of the rock from which it was derived. It should contain these substances in a proportion dependent primarily upon the amount dissolved and carried away during the weathering of the parent rock.

The writer wishes to consider (a) the decomposition of limestones in general, showing the relationship between their chemical constituents and those of their residual clays; and (b) the chemical relations between the clay partings of stylo-lite-seams and the associated limestones, showing that the clays fulfil the requirements of a residual product of the limestones in which they are found.

It has already been pointed out that since limestones are composed, for the most part, of calcium carbonate, their decomposition is effected primarily by solution—especially in humid climates (see p. 48). In the alteration of limestone to residual clay, the soluble constituents of the parent rock are leached out (in varying proportions, depending upon the solubility) and the less soluble constituents are concentrated in the form of a clay residue. By comparing the chemical composition of an original rock with the composition of its decomposed equivalent, one is able to obtain an approximate idea of the loss of the various elements. In order to understand best the changes which take place in limestones, reference should here be made to Tables No. 1, 2, and 3. In these tables, column I is the analysis of the fresh limestone, while column II is that of the residual product. Columns III, IV, and V are calculated from I and II.<sup>7</sup> Column IV shows the percentage of each constituent saved, assuming a certain substance to be constant (silica or alumina), while column V gives the percentage of each constituent lost. Column III, the percentage of loss for the entire rock, is derived by multiplying I by V. The supposition, however, that any element is fixed in amount is erroneous, since the most resistant materials are attacked, to a limited extent, by carbonated waters (Van Hise, 1904, p. 514). In making calculations, the method has been to choose the constituent in which the loss has been least, and by this to gauge the loss of the other substances. A study of the decomposition of limestone shows calcium carbonate to be removed in most appreciable quantities, while

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<sup>7</sup> The formula employed in these calculations is as follows:  $\frac{A}{B \times C} = x$ ; and  $100 -$

$x = y$ , in which A = the percentage of any constituent in the residual material; B = the percentage of the same constituent in the fresh rock; and C = the quotient obtained by dividing the percentage of alumina (or silica, whichever is taken as a constant factor) of the residual material by that in the fresh rock, the final quotient being multiplied by 100. Then x equals the percentage of the original constituent saved, in the residue, and y the percentage of the same constituent lost. (Merrill, G.P., 1921, p. 188, footnote 2.)

TABLE No. 1

Analyses of Fresh Limestone and Its Residual Clay, Batesville, Ark.  
 From: MERRILL, G. P. 1921. Rocks, Rock-Weathering and Soils, p. 217.

CONSTITUENTS	I	II	III	IV	V
	Fresh Limestone	Residual Clay	Percentage of Loss for Entire Rock	Percentage of Each Constit- uent Saved	Percentage of Each Constit- uent Lost
	Per cent	Per cent	Per cent	Per cent	Per cent
Silica ( $\text{SiO}_2$ ).....	4.13	33.69	0.00	100.00*	0.00
Alumina ( $\text{Al}_2\text{O}_3$ ).....	4.19	30.30	0.47	88.65	11.35
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )...	2.35	1.99	2.11	10.44	89.56
Manganic oxide ( $\text{MnO}$ )	4.33	14.98	2.49	42.41	57.59
Lime ( $\text{CaO}$ ).....	44.79	3.91	44.32	1.07	98.93
Magnesia ( $\text{MgO}$ ).....	0.30	0.26	0.27	10.62	89.38
Potash ( $\text{K}_2\text{O}$ ).....	0.35	0.96	0.23	33.63	66.37
Soda ( $\text{Na}_2\text{O}$ ).....	0.16	0.61	0.085	46.74	53.26
Water ( $\text{H}_2\text{O}$ ).....	2.26	10.76	0.95	58.37	41.63
Carbon dioxide ( $\text{CO}_2$ )..	34.10	0.00	34.10	0.00	100.00
Phosphoric acid ( $\text{P}_2\text{O}_5$ )	3.04	2.54	2.73	10.24	89.76
Total.....	100.00	100.00	87.755	.....	.....

\*Silica taken as constant.



TABLE No. 2

Analyses of Fresh Limestone and Its Residual Clay, Staunton, Va.  
From: MERRILL, G. P. 1921. Rocks, Rock-Weathering and Soils, p. 219.

CONSTITUENTS	I	II	III	IV	V
	Fresh Limestone	Residual Clay	Percentage of Loss for Entire Rock	Percentage of Each Constituent Saved	Percentage of Each Constituent Lost
	Per cent	Per cent	Per cent	Per cent	Per cent
Silica ( $\text{SiO}_2$ ).....	7.41	57.57	2.03	72.61	27.39
Titanium dioxide ( $\text{TiO}_2$ ).....					
Alumina ( $\text{Al}_2\text{O}_3$ ).....	1.91	20.44	0.00	100.00*	0.00
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )...	0.98	7.93	0.29	75.11	24.89
Lime ( $\text{CaO}$ ).....	28.29	0.51	28.24	0.17	99.83
Magnesia ( $\text{MgO}$ ).....	18.17	1.21	18.06	0.62	99.38
Potash ( $\text{K}_2\text{O}$ ).....	1.08	4.91	0.62	42.51	57.49
Soda ( $\text{Na}_2\text{O}$ ).....	0.09	0.23	0.07	23.96	76.04
Carbon dioxide ( $\text{CO}_2$ )..	41.57	0.38	41.53	0.85	99.15
Phosphoric acid ( $\text{P}_2\text{O}_5$ )	0.03	0.10	0.02	31.22	69.78
Water ( $\text{H}_2\text{O}$ ).....	0.57	6.69	0.55	Gain	Gain
Total.....	100.00	100.00	90.86	.....	.....

\*Alumina taken as constant.

TABLE No. 3

Analyses of Fresh Limestone and Its Residual Clays (Collected from Two Horizons), Campus of Mississippi Agricultural and Mechanical College. From: LOGAN, W. N. 1907. Mississippi Geological Survey, Bull. 2, Part I, p. 222.

CONSTITUENTS	I	II	III	IV	V	VI	VII	VIII	IX
	Fresh Limestone	Residual Clay	Percentage of Loss for Entire Rock	Percentage of Each Constituent Saved	Percentage of Each Constituent Lost	Residual Clay	Percentage of Loss for Entire Rock	Percentage of Each Constituent Saved	Percentage of Each Constituent Lost
Moisture (H <sub>2</sub> O).	0.81	4.06	0.00	Gain	Gain	2.95	0.00	Gain	Gain
Volatile matter (CO <sub>2</sub> , etc.)....	28.61	8.60	24.75	13.48	86.52	10.90	23.72	17.09	82.91
Silica (SiO <sub>2</sub> )....	27.05	60.43	0.00	*100.00	0.00	56.97	1.55	*94.27	5.73
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> ).....	5.45	10.05	0.94	82.70	17.30	10.40	0.78	85.59	14.41
Alumina (Al <sub>2</sub> O <sub>3</sub> )	6.45	13.15	0.55	91.40	8.60	15.09	Gain	104.00	Gain
Lime (CaO)....	30.21	2.13	29.26	3.16	96.84	1.00	29.76	1.48	98.52
Magnesia (MgO)	0.00	0.54	0.00	Gain	Gain	1.25	0.00	Gain	Gain
Sulphur trioxide (SO <sub>3</sub> ).....	0.32	0.36	0.16	50.45	49.55	0.34	0.17	47.65	52.35
Total.....	98.90	99.32	55.66	.....	.....	98.90	55.98	.....	.....

\*Silica in II taken as constant.

- Column
- I. Fresh Selma limestone.
  - II. Residual clay of I, collected at bottom of deposit near contact with limestone.
  - III. Percentage of loss for entire rock.
  - IV. Percentage of each constituent saved.
  - V. Percentage of each constituent lost.
  - VI. Residual clay of I, collected in middle of deposit, above II.
  - VII. Percentage of loss for entire rock.
  - VIII. Percentage of each constituent saved.
  - IX. Percentage of each constituent lost.

Columns III, IV, V, VII, VIII, IX calculated by the writer.

silica and alumina are least attacked. The amount of lime retained in the residual clays is quite variable. Analyses often show an increase in the percentage of lime upon approaching the parent rock (see Table No. 3, columns II, IV, VI, and VIII). From the analyses of various limestones and their residual clays one learns that in some cases alumina is the most constant constituent, and in others, silica. If pyrite is present in the limestone, the alumina may be removed in part as aluminum sulfate. Where alkalies are almost wholly lacking in the fresh rock, it is believed that one is safe in saying that little or no silica is lost thru the action of alkaline carbonates (Merrill, G.P., 1921, p. 217). As the Tables No. 1, 2, and 3 (column IV) show, most of the silica and alumina of the parent rock is saved, and one is safe in assuming that neither of these constituents is lost in appreciable quantities in the decomposition of limestone. Magnesium carbonate is generally more resistant than calcium carbonate, altho Van Hise points out that "in some instances more magnesia is dissolved than lime" (Van Hise, 1904, p. 516). A good portion of the potash and soda remains in the clay, these materials being less soluble than either magnesia or lime. C. H. Smyth, Jr. (1913, *Jour. Geol.*, Vol. 21, pp. 105-120) shows that the solubility of potash is low as compared with that of calcium carbonate. The solubility of soda, however, is often fairly high, altho variable.

The amount of iron leached out varies greatly and irregularly (see Tables No. 1, 2, and 3; column V).

Doubtless this variability is dependent upon the fact that iron occurs in both the ferrous and ferric forms—the former being more readily soluble. Where the iron is mainly ferrous, one would expect that a larger proportion would be dissolved; where ferric, a smaller proportion (Van Hise, 1904, p. 517).

In the complete decomposition of any rock, the ferrous oxide (which has not been leached out) is almost entirely oxidized to the ferric state. A striking characteristic of residual clays is the high percentage of ferric oxide as compared with the small amount of ferrous oxide (see analyses of residual clays: Clarke, F. W., 1916, pp. 507-508; Merrill, G.P., 1921, p. 294). In sedimentary clays and shales one usually finds a considerable portion of the iron as ferrous oxide. This is surprisingly well shown in a composite analysis of fifty-one Paleozoic

shales which show 2.90 per cent of FeO and 4.04 per cent of  $\text{Fe}_2\text{O}_3$  (Clarke, F.W., 1916, p. 546). Clarke points out that

In the shales the proportion of ferrous relatively to ferric oxide has increased; probably because of the reducing action of organic matter in the sediments as they were first laid down. Ferric oxide has been evidently reduced, and organic substances furnish the most obvious reagents for producing such an alteration.

That most of the parent limestone is lost in its decomposition is well shown in Tables No. 1 and 2, column III. In the first, 87.75 per cent of the original rock was lost, while in the second, 90.86 per cent. The amount of loss of the parent rock is dependent, of course, upon the quantity of soluble materials. The order of loss of the various constituents is somewhat variable in different cases, but commonly occurs as follows:

- a. Lime—removed in most appreciable quantities, usually 90-100 per cent.
- b. Magnesia—usually more resistant than lime, altho in some instances it is dissolved more rapidly than the lime.
- c. Soda—solubility often fairly high, altho variable.
- d. Potash—solubility low as compared with lime.
- e. Iron oxide—solubility quite variable, depending upon whether it exists as ferrous or ferric oxide, the former being more readily dissolved. Most of the iron of the residual clay occurs as ferric oxide.
- f. Alumina—practically insoluble. It may be removed in part, however, as aluminum sulfate, if the limestone contains pyrite.
- g. Silica—practically insoluble. It may also be partially leached out if the rock contains alkalies in appreciable quantities.

The writer wishes to present three tables of analyses—Tables No. 4, 5, and 6—to show the chemical relationship between the clay partings of stylolite-seams and the associated limestones. Each table gives the analysis of the fresh limestone (column I); the analysis of the clay of the stylolite-seam (column II); the percentage of loss of the entire rock (column III); the percentage of each constituent saved (column IV); and the percentage of each constituent lost (column V). Columns III, IV, and V were calculated on the



assumption that the clays are residual, in view of determining whether or not they fulfil the requirements of a solution residue of the limestone in which they are found.

In selecting material for the analyses one must take precautions that the samples are properly related—the limestone must be the nearest possible to that from which the clay was supposedly derived. Thus, the limestone directly above an upward-penetrating stylolite would probably be a fair test of the stone from which the clay cap was derived, unless there had been also some solution of the column itself. The limestone of the adjacent downward-penetrating stylolite would also furnish a fair test of the material which had been removed next to it. Since the clays are so thin, difficulty is experienced in collecting material which is entirely free from particles of the adjacent country rock. At the best, one can hardly expect to procure a sample which would give an errorless analysis of the missing dissolved limestone. The following analyses, however, show surprising results:

TABLE No. 4

Analyses of Salem Limestone (Blue) and Residual Clay of Associated Stylolite-Seam, from Quarry of Consolidated Stone Company, Dark Hollow District, Lawrence County, Ind.

CONSTITUENTS	I		II		III	IV	V
	Fresh Limestone		Residual Clay		Percentage of Loss for Entire Rock	Percentage of Each Constituent Saved	Percentage of Each Constituent Lost
Silica ( $\text{SiO}_2$ ).....	0.84	.....	29.64	.....	0.10	88.30	11.70
Alumina ( $\text{Al}_2\text{O}_3$ )...	0.18	.....	7.16	.....	0.00	100.00*	0.00
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	0.04	.....	8.22	} .....	0.56	28.30	71.70
Ferrous oxide ( $\text{FeO}$ )	0.76	.....	0.84				
Ferrous carbonate ( $\text{FeCO}_3$ ).....	.....	0.55	.....	.....	.....	.....	.....
Lime ( $\text{CaO}$ ).....	54.04	.....	14.80	.....	51.40	6.80	93.20
Calcium carbonate ( $\text{CaCO}_3$ ).....	.....	96.50	.....	.....	.....	.....	.....
Magnesia ( $\text{MgO}$ )...	0.08	.....	0.44	.....	0.07	13.80	86.20
Magnesium carbonate ( $\text{MgCO}_3$ )...	.....	0.17	.....	.....	.....	.....	.....
Potash ( $\text{K}_2\text{O}$ ).....	} 0.15	.....	3.58	.....	0.06	59.60	41.40
Soda ( $\text{Na}_2\text{O}$ ).....							
Total silicates and oxides not combined with $\text{CO}_2$ .....	.....	1.63	.....	49.44	.....	.....	.....
Carbon dioxide ( $\text{CO}_2$ ).....	42.76	.....	12.10	.....	39.72	7.10	92.90
Volatile and combustible matter, less $\text{CO}_2$ .....	0.60	0.60	19.14	19.14	0.12	79.80	20.20
Total.....	99.45	99.45	95.92	.....	91.50	.....	.....

\*Alumina taken as constant.

Column I. Fresh Salem limestone (blue variety).

II. Black residual clay of stylolite-seam associated with I.

Analyses by Kenneth W. Ray, Indiana University, 1921.

Columns III, IV, V calculated by the writer.

TABLE No. 5

Analyses of Salem Limestone (Buff) and Residual Clay of Associated Stylolite-Seam, from Quarry of Consolidated Stone Company, Dark Hollow District, Lawrence County, Ind.

CONSTITUENTS	I		II		III	IV	V
	Fresh Limestone		Residual Clay		Percentage of Loss for Entire Rock	Percentage of Each Constituent Saved	Percentage of Each Constituent Lost
Silica ( $\text{SiO}_2$ ).....	0.89	.....	39.92	.....	0.00	100.00*	0.0
Alumina ( $\text{Al}_2\text{O}_3$ )...	0.20	.....	8.76	.....	0.005	97.30	2.7
Ferric oxide ( $\text{Fe}_2\text{O}_3$ )	0.04	.....	14.41	} .....	0.11	76.10	23.9
Ferrous oxide ( $\text{FeO}$ )	0.41	.....	1.01				
Ferrous carbonate ( $\text{FeCO}_3$ ).....	0.47	.....	.....	.....	.....	.....	.....
Lime ( $\text{CaO}$ ).....	53.28	.....	15.68	.....	49.80	6.60	93.4
Calcium carbonate ( $\text{CaCO}_3$ ).....	95.14	.....	.....	.....	.....	.....	.....
Magnesia ( $\text{MgO}$ )...	0.54	.....	0.08	.....	0.52	3.30	96.7
Magnesium carbonate ( $\text{MgCO}_2$ )...	1.13	.....	.....	.....	.....	.....	.....
Potash ( $\text{K}_2\text{O}$ ).....	} 0.07	.....	1.56	.....	0.036	49.50	51.5
Soda ( $\text{Na}_2\text{O}$ ).....							
Total silicates and oxides not combined with $\text{CO}_2$ ..	1.32	.....	65.74	.....	.....	.....	.....
Carbon dioxide ( $\text{CO}_2$ ).....	42.63	.....	9.52	.....	40.40	4.90	95.1
Volatile and combustible matter, less $\text{CO}_2$ .....	0.43	0.43	7.94	7.94	0.26	39.00	61.0
Total.....	98.49	98.49	98.88	.....	91.135	.....	.....

\*Silica taken as constant.

Column I. Fresh Salem limestone (buff variety).

II. Brown residual clay of stylolite-seam associated with I.

Analyses by Kenneth W. Ray, Indiana University, 1921.

Columns III, IV, V calculated by the writer.

TABLE No. 6

Analyses of Harrodsburg Limestone and Residual Clay of Associated Stylolite-Seam, from Quarry Two Miles Northeast of Bloomington, Ind.

CONSTITUENTS	I		II		III	IV	V
	Fresh Limestone		Residual Clay		Percentage of Loss for Entire Rock	Percentage of Each Constituent Saved	Percentage of Each Constituent Lost
Silica ( $\text{SiO}_2$ ).....	9.58	.....	33.68	.....	0.00	100.00*	0.0
Alumina ( $\text{Al}_2\text{O}_3$ )...	3.39	.....	10.78	.....	0.31	90.9	9.1
Ferric oxide( $\text{Fe}_2\text{O}_3$ )	2.18	.....	6.56	.....	0.22	88.9	11.1
Lime ( $\text{CaO}$ ).....	41.74	.....	17.94	.....	36.60	12.3	87.7
Calcium carbonate ( $\text{CaCO}_3$ ).....	74.49	.....	.....	.....	.....	.....	.....
Magnesia ( $\text{MgO}$ )...	3.97	.....	1.89	.....	3.43	13.6	86.4
Magnesium carbonate ( $\text{MgCO}_3$ )...	8.30	.....	.....	.....	.....	.....	.....
Total silicates and oxides not combined with $\text{CO}_2$ ...	15.15	.....	51.02	.....	.....	.....	.....
Carbon dioxide ( $\text{CO}_2$ ).....	37.08	.....	16.14	.....	32.44	12.5	87.5
Volatile and combustible matter, less $\text{CO}_2$ .....	1.51	1.51	3.98	3.98	0.37	75.7	24.3
Total.....	99.45	99.45	90.97	.....	73.37	.....	.....

\*Silica taken as constant.

Column I. Fresh Harrodsburg limestone.

II. Gray residual clay of stylolite-seam associated with I.

Analyses by J. C. Warner, Indiana University, 1920.

Determinations for  $\text{FeO}$ ,  $\text{FeCO}_3$ ,  $\text{K}_2\text{O}$ , and  $\text{Na}_2\text{O}$  were not made.

Columns III, IV, V calculated by the writer.



It has been shown that, in the transformation of limestone to residual clay, silica and alumina are two constituents which are retained with little or no loss. Therefore, one finds that practically the same ratio exists between the silica and alumina of a parent limestone and the silica and alumina of the derived clay (see Tables No. 1, 2, and 3; columns I and II). In the above analyses of limestones and stylolite-clays several relationships are striking and convincing. In Table No. 4 the fresh limestone contains 0.84 per cent silica and 0.18 per cent alumina—a ratio of about 4.6 to 1. In the clay there is 29.64 per cent silica and 7.16 per cent alumina—a ratio of 4.1 to 1. The limestone of Table No. 5 contains 0.89 per cent silica and 0.20 per cent alumina, the ratio being 4.45 to 1; the associated clay has 39.92 per cent silica and 8.76 per cent alumina, the proportion being about 4.5 to 1. In the limestone of Table No. 6 there is 9.58 per cent silica to 3.39 per cent alumina, while in the clay the amounts are 33.68 per cent and 10.78 per cent. In both analyses (limestone and associated clay) silica and alumina occur in approximately the same ratio, 3 to 1. Thus it is seen, in the three above sets of analyses, that, as far as the ratio between silica and alumina is concerned, the clays of the stylolite-seams fulfil the requirements of a residual limestone clay.

A study of the relationship of the iron oxide content of the fresh limestone to that of the stylolite-clay also reveals evidence that the clay is of residual origin. In the limestones (Tables No. 4 and 5; column I), one finds the iron oxide existing principally as ferrous oxide, with but a bare trace of ferric oxide; while in the clays (column II), the reverse is noted. An oxidation of ferrous to ferric oxide is normal in the decomposition of limestone to residual clay (see p. 72). If the clays of the stylolite-seams were of sedimentary origin—as exponents of the pressure theory would have them—one would expect to find a considerable portion of their iron as ferrous oxide. As the analyses show, however, the ferrous oxide is low compared to the ferric. It is seen also that in Table No. 4 there is a greater loss of iron oxide (column V) than in Table No. 5. Such is to be expected in view of the fact that in the limestone of the former the percentage of ferrous oxide is greater than in that of the latter. Where the iron is mainly ferrous, one may expect considerable proportions to be dissolved (see p. 72). Thus, from the analyses,

it is seen that the behavior of the iron content is as should be expected in the transformation of a limestone to its residual clay.

In considering the proportionate amount of lime, one finds that the greatest percentage of that of the parent rock has been lost—assuming, of course, that the clays are of residual origin. The analyses show a loss of 93.20 per cent, 93.40 per cent, and 87.70 per cent in Tables No. 4, 5, and 6 respectively (column V). This is hardly as great a loss of lime as usually is found in the decomposition of limestone, altho it compares very favorably with some analyses. The lime content of the clay can readily be accounted for by the occurrence of corroded fossil fragments which have not been completely dissolved (see p. 85), and also by the fact that difficulty is found in collecting clay which is entirely free from particles of the adjacent country rock. In the second place, one should hardly expect as thoro a leaching of the calcium carbonate of a stylolite clay seam as that of a residual limestone soil. Residual limestone clays are formed on top of the bed rock and are continually being acted upon by fresh meteoric waters; while stylolite-clays, which occur within the strata, are subjected to the action of waters which have passed thru the overlying bed rock and are already more or less saturated with calcium carbonate.

The analyses also show the expected loss of magnesia. In Tables No. 4 and 6 the amount of magnesia lost is somewhat less than that of lime, while in No. 5 it is slightly greater. The tables also show that most of the carbon dioxide was lost—92.90 per cent, 95.10 per cent, and 87.50 per cent in Tables No. 4, 5, and 6, respectively. The carbon dioxide content of a residual clay is dependent, principally, upon the amount of lime and magnesia with which it is united as carbonates. The analyses show further that the loss of potash and soda is as should be expected in the decomposition of a limestone. These two constituents, being less soluble than lime or magnesia, would normally be retained in greater quantities.

Table No. 7 is compiled for a comparison of the percentages of various constituents lost. The first three columns (taken from Tables No. 1, 2, and 3) show the percentages of the materials lost in the transformation of limestone to residual clay soil; while the last three columns (taken from

Tables No. 4, 5, and 6) show the loss in the formation of the clays of the stylolite-seams, assuming the clays to be of residual origin. One finds, in making a careful study of this comparison, that the loss of the various constituents in the stylolite-clays is in direct accord with that in the transformation of a limestone to its residual product. If the stylolite-clays were of sedimentary origin, one surely would not expect this relationship to exist.

TABLE No. 7

Table for a Comparison of the Percentages of Various Constituents Lost in the Transformation of Limestones to Their Residual Clays.

Compiled from Column V of the preceding analyses, Tables No. 1-6.

CONSTITUENTS	Residual Limestone Clays			Clays of Stylolite— Seams		
	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
Silica ( $\text{SiO}_2$ ).....	0.00*	27.39	0.00*	11.70	0.00*	0.00*
Alumina ( $\text{Al}_2\text{O}_3$ ).....	11.35	0.00*	8.60	0.00*	2.70	9.10
Ferric oxide ( $\text{Fe}_2\text{O}_3$ ) ...	89.56	24.89	17.30	71.70	23.90	11.10
Ferrous oxide ( $\text{FeO}$ )...						
Lime ( $\text{CaO}$ ).....	98.93	99.83	96.84	93.20	93.40	87.70
Magnesia ( $\text{MgO}$ ).....	89.38	99.38	Gain	86.20	96.70	86.40
Potash ( $\text{K}_2\text{O}$ ).....	66.37	57.49	.....	41.40	51.50	.....
Soda ( $\text{Na}_2\text{O}$ ).....	53.26	76.04				
Carbon dioxide ( $\text{CO}_2$ ) ...	100.00	99.15	86.52	92.90	95.10	87.50
Water ( $\text{H}_2\text{O}$ ).....	41.63	Gain	Gain	.....	.....	.....
Volatile and combustible matter, less $\text{CO}_2$ .....	.....	.....	.....	20.20	61.00	24.30

\*Taken as constant.

Since the per cent of soluble constituents in the limestones of Tables No. 4 and 5 is very high, one would expect a large proportion of the parent rock to be lost when decomposed. The calculations show a total loss for the entire rock of 91.50 per cent and 91.135 per cent (column III). These samples were collected from the same quarry, but from different stylolite-seams. Thus, the figures show that solution affected both limestones equally. Such would be expected. Since less than 9 per cent (by weight) of the limestone is saved, it is readily seen that a considerable amount of decomposed limestone would be necessary to produce a small deposit of residue.

The clay caps of the stylolites of the Salem limestone are always thin in comparison with the length of the stylolite (the length of the stylolite gives a fair measure of the amount of solution which has occurred). In the quarry from which the samples of Tables No. 4 and 5 were collected, stylolites about 1 foot in length bear well-compacted clay caps not over  $\frac{3}{8}$  to  $\frac{1}{2}$  inch in thickness. In no instance is the clay parting too thick to be explained by the solution theory. The samples in Table No. 6 were collected from an impure stratum of Harrodsburg limestone. In the decomposition of this limestone, less of the original rock, as compared with the Salem limestone, would be lost by solution and a greater proportion left to accumulate as residual clay. Calculations show 73.37 per cent loss (by weight) for the entire rock (column III). The stylolites of this formation bear clay caps of a proportionately greater thickness than those of the Salem limestone. Fairly short, massive stylolites have clay caps up to an inch or more in thickness.

From the foregoing study of the chemical relations between the clay partings of stylolite-seams and the associated limestones, one can realize the conclusive evidence that the stylolite-clays fulfil the requirements of a residual product of the limestones in which they are found.

The analyses show that the general assumption, made by Hopkins and other observers, that the black and brown stylolite clay partings are of a highly carbonaceous nature, is a faulty one, since the content of volatile and combustible matter (less  $\text{CO}_2$ ) is less than 20 per cent (see Tables No. 4 and 5; column II). In all instances there has been a loss of the volatile and combustible matter of the original rock. This is due to the expected oxidation and volatilization of a portion of the carbon content.

It should be noted that the limestones of Tables No. 4 and 5 contain only a trace of ferric oxide (in each instance 0.04 per cent) and a much greater amount of ferrous oxide. The analyses reveal further that they contain 0.60 per cent and 0.43 per cent, respectively, of combustible matter (carbon). The limestone of Table No. 4 is the so-called "blue" variety, while that of No. 5 is the "buff" stone. The writer believes that the generally accepted theory that the buff stone



is derived from the original blue as a result, primarily, of the oxidation of the ferrous oxide to the ferric, and, secondarily, of the oxidation of the organic matter to some volatile form, furnishes a problem worthy of further consideration. The analyses, referred to above, do not support the theory in regard to the iron oxide, since each sample of stone contains the same amount. Thus, the quantity of  $\text{Fe}_2\text{O}_3$  could not account for the difference in color of the two samples. However, the expected relation in organic matter is noted, the blue stone containing 0.60 per cent, and the buff, 0.43 per cent. With a view to determine the cause of the coloration, Hopkins submitted three sets of analyses, of the two varieties of Salem limestone, which were not as satisfactory as might be desired (Hopkins and Siebenthal, 1897, p. 309; 1908, p. 315). In all cases the amount of ferric oxide was very small, less than 0.20 per cent, and did not substantially support the theory with regard to the coloration. In two of the three sets of analyses, the buff stone showed a slightly higher percentage of  $\text{Fe}_2\text{O}_3$ ; but in one case the blue stone contained the greater amount. Hopkins pointed out that "the percentages are so small that it is doubtful whether the differences are due to more than the possible errors incident to manipulation". The analyses showed further, however, that the organic matter in each case was only half as much in the buff as in the blue stone. It should be borne in mind that the difference in color of the blue and buff stone is not great, sometimes scarcely perceptible in a hand specimen, but is often quite distinct on a large block or quarry face. In face of the limited evidence, the writer is inclined to believe the slight difference in color is due, primarily, to variations in the amount of organic matter.

There is always a definite relationship between the color of the clay partings of stylolite-seams and that of the associated limestone. Stylolites of the blue stone bear black caps; those of the buff stone, brown caps. From the analyses (Tables No. 4 and 5), one finds that the black residual clay from the blue stone contains 19.14 per cent organic matter and 8.22 per cent ferric oxide; whereas the brown clay of the buff stone has but 7.94 per cent combustible matter, and 14.41 per cent ferric oxide. In either clay the ferric oxide exists in more than sufficient quantity to produce a reddish

brown color, altho the clay of Table No. 4 is black. Ries (1914, p. 109) points out that

Carbonaceous matter often serves as a strong coloring agent of raw clays. If present in small amounts it tinges them gray or bluish gray, while larger quantities cause a black coloration. Indeed, so strong may this be that it masks the effect of other coloring agents such as iron.

If the blue stone contains a greater quantity of carbonaceous matter than the buff, one should naturally expect the same relationship to exist in the residual clays. If the color of the buff stone is secondary, due to an alteration of the iron and carbon content, the question next arises as to whether or not the stylolite-seams originated before or after the color change in the rock took place (sec p. 59). If the stylolites all originated in the blue rock, the writer would believe the stylolite-clays all to have been originally black, with a good percentage of organic matter. The brown clays of today, then, result from a subsequent oxidation and volatilization of the carbon content, the process accompanying the color change of the parent limestone.

RELATION BETWEEN THE THICKNESS OF THE CLAY CAPS AND THE SIZE AND COMPOSITION OF THE STYLOLITES. In addition to the important relationships between the chemical composition of the clay caps and the associated limestones, field investigations lead to the following conclusions:

1. The thickness of the clay caps varies in direct proportion to the length of the stylolites.
2. The thickness of the clay caps varies in inverse proportion to the purity of the limestone.

These two conclusions are logical if the clay partings are the solution residue of the dissolved limestone. In the Salem limestone, the smallest stylolites bear clay caps which are extremely thin, while larger stylolites have clays proportionately thicker. Invariably, this relationship is observed. That the thickness of the clay varies in inverse proportion to the purity of the limestone is especially striking in comparing the clays of the stylolites of the impure Harrodsburg limestone with those of the pure Salem limestone (see pp. 80-81). For example, six-inch stylolites of the former have as much as an inch or more of clay, while the same sized columns of the latter bear caps as thin as an eighth of an inch. Analyses



FIG. 34.—Stylolites of the Salem limestone, showing a double clay parting, separated by a thin layer of limestone, at the top of the wide column on the left. The other columns have single clay caps. Note the well-defined striations on the sides of the columns at the right. From a quarry of the Consolidated Stone Company, Dark Hollow district, Lawrence County, Ind.

show the Harrodsburg limestone to contain as much as six to eight times the amount of insoluble constituents as the Salem limestone (compare Table No. 5 with No. 6).

That the clay partings and the associated stylolites always show a definite chemical and physical relationship is certainly not a coincidence. It is conclusive proof that the clay is a residue from the solution of the limestone.

**OCCURRENCE OF CORRODED FOSSIL FRAGMENTS IN THE CLAY RESIDUE.** The presence of corroded fossil fragments in the clay caps speaks for itself. Altho often only microscopically visible, they are to be found. They are the partially dissolved remains of the original limestone, and make up a considerable portion of the subordinate calcium carbonate content of the residual clay.

**SUBORDINATE FEATURES OF THE CLAY CAPS.** Stylolite caps often present a compressed and semi-laminated appearance. Since the circulation of ground waters would be variable, one should not always expect a uniform, even rate of solution to take place. A retardation or pause in the solution would produce a consequent pause in the deposition of the residue and thus give a laminated appearance to the deposit. Altho the line of contact between the clay caps and the ends of the columns is usually sharply defined, a few examples were found which show a slight gradation resulting from a partial solution of the limestone column itself.

Occasionally, stylolites are found which have what might be termed a "double cap", where the end of the column is marked by two layers of clay separated by a thin layer of limestone (see Fig. 34). In such a case the solution has been divided between two crevices, and the combined thickness of the clay of the two partings of the one column is equal to that of the single cap of the adjacent column. Analogous to this, a stylolite frequently contains one or more small, subordinate stylolite-seams crossing it at right angles (usually near the end), while the surrounding columns show none. This is nothing more than subordinate solution which has taken place along crevices of this one major projection and has produced within it minor stylolite-seams (see Fig. 26).



### 3. Stratigraphic Evidence which Precludes the Pressure Theory and Supports the Solution Theory

OCCURRENCE OF STYLOLITES ONLY IN SOLUBLE ROCKS. Investigation of the geologic distribution of stylolites reveals indirect evidence that the phenomenon is one of solution. The fact that stylolites occur only in carbonate rocks—varieties of limestones, dolomites, and marbles—suggests solution as a factor, or otherwise they would not be limited to soluble rock strata (see p. 13). If the pressure theories of Marsh, Gumbel, Rothpletz, and others explain their origin, why should stylolites not be found in shales, sandstones, etc.? Could not Gumbel's experiment (see p. 27) be applied to rocks other than soluble ones?

OCCURRENCE OF ANGULAR STYLOLITE-SEAMS. It is interesting to note that in undisturbed strata, such as the southern Indiana limestones, the direction of stylolite penetrations is vertical (with but few exceptions), resulting from the static pressure of the overlying mass; and the direction of the stylolite-seams is usually horizontal, or nearly so, and parallel with the planes of stratification. However, in some instances, stylolites have developed along angular crevices which cut across the stratification (see Fig. 17). A normal fault surface, in one case, was stylolitic. In disturbed or metamorphic strata, where lateral pressure has been active, such as in the Muschelkalk of Germany and the Tennessee marble, stylolites run in all directions, the occurrence of vertical seams even being common. Stylolite-sutures which cross one another are observed. Since the pressure theory considers the clay caps of the columns as an original deposit of clay laid down in due order with the rest of the sediments, how can it explain the clay partings of angular to vertical stylolite-seams which cut across the stratification of the rock at various angles? These partings are undoubtedly not original deposits of clay, for they are by no means limited to the stratification planes of the stone (see pp. 44, 54, 67).

OCCURRENCE OF BRANCHING STYLOLITE-SEAMS. Commonly there are found two or more parallel stylolite-seams which converge and join into one larger seam, producing what might be called a "branching stylolite-seam" (see Figs. 35 and 36). This major, single seam sometimes continues some distance, and then branches again. The subordinate branches, after

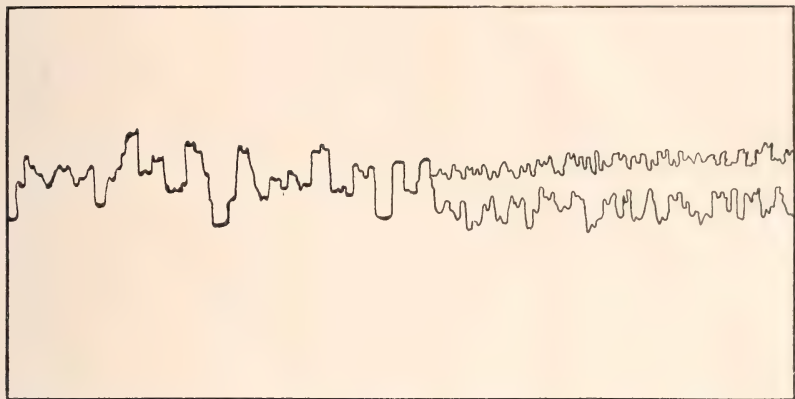


FIG. 35.—Diagram of a branching stylolite-seam in the Mitchell limestone. Note that the combined length of the columns of the two minor, branching seams is equivalent to that of the stylolites of the major, single seam. Three-fourths natural size.

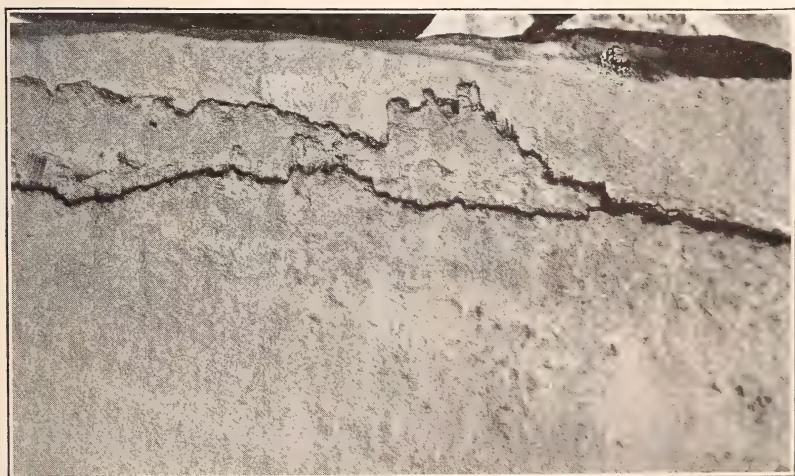


FIG. 36.—Branching stylolite-seam in the Salem limestone. Note that the combined thickness of the black clay of the two branching seams is equivalent to that of the major, single seam.

continuing parallel, often again converge into a single seam. In such cases, the combined thickness of the clay residue of the branching seams is equal to the thickness of that of the larger, single seam (see Fig. 36). At the places of branching, these subordinate seams cut across the lamination at a small angle. Such phenomena result from solution along a branching crevice. How could such a stratigraphic distribution of clay be explained by the pressure theory? The explanation of "double caps" (see p. 85) would also be very difficult by other theories than that of solution.

**OCCURRENCE OF STYLOLITES ALONG DISCONFORMITIES.** The occurrence of stylolites along the disconformable contact of two different geologic formations furnishes unusual evidence that the phenomena originated by the actual removal of hardened rock, rather than by the differential compression of plastic sediments. The writer has in mind, especially, the presence of stylolites along the undulating contact of the Monroe (Silurian) with the Columbus (Devonian) limestones of central Ohio<sup>8</sup>, and along the disconformity between the Louisville (Silurian) and Geneva (Devonian) limestones of southern Indiana. The latter observation was made by the writer in the vicinity of North Vernon, Ind. Here, the unconformity represents a "lost interval" of several geologic ages, the Louisville limestone being Niagaran (Lockport) in age, while the Geneva limestone is correlated with the Onondaga. It is an absurdity, of course, to conceive the two formations as having existed as soft plastic rock at the same time, as would be necessary under the pressure theory.

#### **4. Other Evidence which Supports the Solution Theory**

**DEPOSITS OF MINERAL MATTER.** Since there is an excess amount of solution of mineral matter at the ends of stylolites, because of the increase in pressure there, the solvent might become supersaturated, in which case a precipitation of the excess mineral matter would take place in the cavities and crevices where the pressure is less or absent (see pp. 50 and 66). Abundant evidence of this is found in field investigations. The presence of mineral matter on the side-surfaces of the columns (where pressure is at a minimum) has long

<sup>8</sup> Observations at this horizon have been made by Professor J. Ernest Carman, in his studies of the Monroe formation of Ohio.



been known, and gave rise to the early suggestions of the crystallization theory (see p. 22). The occurrence of calcite, gypsum, magnesium sulfate, and strontium sulfate has been described by various writers. Deposits of calcite, with often a subordinate amount of pyrite, are the principal ones found in connection with Indiana stylolites. Coatings of calcite on the sides of the columns occur sometimes with a thickness of as much as  $1/16$  of an inch or more. The deposits are thicker, in many cases, nearer the end (the older part) than the base of a column. Such deposits have usually been slickensided by further growth and interpenetration. This feature is unexplained by all other theories. Since the sides of stylolites are free from pressure, the deposition of mineral matter there is to be expected.

Several examples are found where small joints in the stratum immediately underlying a stylolite-seam are infiltrated with calcite. This mineral matter was no doubt derived from the solution of the limestone along the stylolite-parting. Fractures on the convex side of curved stylolites are often filled with mineral matter. Wagner stresses this observation (Wagner, 1913, p. 118). Various minor evidences of the deposition of mineral matter in connection with stylolites are common.

ANALOGY OF THE ORIGIN OF STYLOLITES TO THAT OF IMPRESSED PEBBLES. The occurrence of the phenomenon of impressed pebbles (of the solution type—see p. 16) is in itself evidence in support of the solution theory of stylolites. In both phenomena—impressed pebbles and stylolites—the solution of the one part results at the point of pressure of the other. Rothpletz's observation of two impressed limestone pebbles whose contact was marked by a minute stylolite-suture (see p. 18, and Figs. 9 and 10) is an observation in direct support of the solution theory of the origin of stylolites. Here was a case of an impression in a pebble resulting from the actual removal of hardened rock material by solution, where the contact with the pressed-in pebble was slightly interteethed as a result of subordinate differential solution.

## CONCLUSION

The abundance of evidence in support of the solution theory of the origin of stylolites establishes the conclusion that



the solution of limestone, under pressure, and the resulting production of residual material are geologic processes which may have considerable bearing upon the explanation of various stratigraphic features and peculiarities of limestones. One can readily see that the occurrence of stylolites, themselves, indicates a secondary change of no little importance in the parent limestone. Not only are the original limestone strata reduced in thickness (which may be considerable in a highly stylolitic formation), but a secondary clay, of residual origin, is introduced. The writer is firmly convinced that many of the thin clay partings in limestones—always heretofore referred to as sedimentary clays or shales—are of residual origin, produced by solution of the limestone along a bedding plane or lamination plane. Stylolites result where the limestone exhibits a *differential* resistance to solution. If the rock on each side of a solution crevice were of uniform resistance, stylolitic interteething would hardly result. Continued solution would give only a slightly undulating seam, with a residual clay parting (see p. 53; also Figs. 20 and 21). The possibilities of secondary modifications of limestone beds by solution, with the production of residual clays, should not be overlooked.

### SUMMARY

Detailed field investigations of stylolites reveal many features and complexities which can be satisfactorily explained only by the solution theory—that stylolitic phenomena result from the differential chemical solution of hardened rock, under pressure, on the two sides of a bedding plane, lamination plane, or crevice, the undissolved portions of the one side fitting into the dissolved-out parts of the opposite, the interfitting taking place slowly and gradually as solution continues. The clay caps of the stylolites are a residual product of the limestone which has been dissolved.

A careful study of stylolitic structures discloses many features which are unexplained not only by the older unestablished theories, but by the gas theory of Zelger and Potonié, and the pressure theories of Quenstedt, Thurmann, Marsh, Gümbel, and Rothpletz. The writer wishes to present the following summary of the more important observations which conclusively establish the solution theory of the origin of stylolites and oppose the other theories:

1. Stylolites originate in *hardened*, and not plastic rock, with the actual removal of rock material. They do not result from a differential compression of soft sediment. Evidence in support of this:

a. The laminae of stylolites are sharply cut off at the edges of each column. There is no evidence of disturbance or compression of the lamination of the columns, or of the rock above and below the columns.

b. Small, once-continuous stylolite-seams appearing across every other column of a major stylolite-suture are found. The missing portions of the once-continuous, minor parting have been actually removed by the penetration of the larger columns of the major seam.

c. A slight sagging of stylolite-seams, equivalent to the amount of penetration of the columns, is occasionally observed.

d. Stylolites have the exact lithologic characteristics, and color, of the stratum from which they protrude.

e. Fossils, oölitic grains, and mineral crystals are sharply cut off, with no evidence of disturbance, at the contact of the sides of the interpenetrating columns. The missing parts are not to be found.

f. Large fossil shells are often completely pierced or partially penetrated by stylolites.

g. Adjacent, parallel stylolite-seams often partially penetrate one another.

h. The side-surfaces of stylolites are always striated, and mineral deposits on them are slickensided.

i. Stylolite-columns are not intercemented as should be expected if they were formed in plastic sediment before the cementation and hardening of the rock took place.

j. Stylolites are found along inclined bedding planes, with their direction of penetration vertical, instead of at right angles to the stratification as the pressure theory would require.

2. Stylolite-seams are always characterized by a parting of clay which rests as a thin cap at the end of each column. This clay is the solution residue of the dissolved lime-mass. The most important evidence in support of this:

a. There is a definite relationship between the chemical constituents of the clay and the constituents of the associ-

ated limestone. Chemical analyses show the constituents of the clays to fulfil all the requirements of a residual product of the limestone in which they are found. The insoluble substances exist in the same proportions in both the residual clay and the limestone from which the clay was derived.

*b.* The thickness of the clay caps varies in direct proportion to the length of the stylolites.

*c.* The thickness of the clay caps varies in inverse proportion to the purity of the limestone. Stylolites of the purest limestones have the thinnest caps.

*d.* There is always a definite relationship between the color of the stylolite-clays and the color of the associated limestone.

*e.* Corroded fossil fragments are found in the clay caps.

3. Certain geologic and stratigraphic relations suggest evidence which precludes all theories but the solution theory. The most important are:

*a.* The occurrence of stylolitic phenomena is limited to carbonate rocks—rocks which are soluble.

*b.* The pressure theory explains the clay partings as original deposits of clay laid down in due order with the other sediments. Therefore the direction of stylolite-seams would of necessity be parallel with the stratification of the rock. Field observations show numerous examples of stylolite-partings cutting across the lamination at various angles—in some cases at right angles.

*c.* Branching stylolite-seams are common.

*d.* Stylolites occur along unconformities between geologic formations.

4. Other evidence in support of the solution theory follows:

*a.* Various deposits of mineral matter are associated with stylolitic phenomena. They result from a supersaturation of the ground waters as a result of increased solution at the ends of the columns where the pressure is greatest.

*b.* The origin of stylolites is somewhat analogous to that of the solution type of impressed pebbles.

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